IFKAD
International Forum on Knowledge Asset Dynamics

18th International Forum on Knowledge Asset Dynamics

PROCEEDINGS

Managing Knowledge for Sustainability

7-9 June 2023
Matera, Italy

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FOREWORD

Managing Knowledge for Sustainability

Welcome to the 18th International Forum on Knowledge Asset Dynamics (IFKAD 2023) co-hosted by the University of Basilicata and the University of LUM Giuseppe Degennaro in the inspiring city of Matera, Italy. We are delighted to have you here.

The current IFKAD edition is a major milestone as it marks the event's 18th year since its establishment. IFKAD is recognized as a significant international event that emphasizes the importance of knowledge as a driver of innovation, performance improvement, and value creation at the individual, organizational, and territorial levels. This achievement results from the dedication, interest, and involvement of the entire IFKAD community, including the chairpersons, organizers, delegates, scientific committee, keynote speakers, and journal editors and publishers.

We can be happy about achieving our goal but are also motivated to continue improving the conference's overall mission and impact. This includes enhancing the content's quality, increasing journal publication rates, and improving event management.

IFKAD is bringing together world thought leaders, academicians, young researchers, practitioners, and policymakers from different fields to discuss and debate new approaches, models, tools, and practices of knowledge and innovation management. This year's conference will focus on addressing growing pressures and emerging opportunities related to the "sustainability agenda", with high-quality and extensive participation guaranteed, as always.

Knowledge management is now widely recognized as critical for maintaining and improving an organization's competitive advantage. Recently, there has been a renewed emphasis on the significance of knowledge-based strategies and factors in promoting sustainability. This involves various environmental, political, economic, and socio-cultural issues. These aspects are essential in enabling managerial and policy approaches towards sustainability.

The growing focus on sustainability means that organizations need to adapt their business models and values to prioritize social and environmental responsibility alongside economic success. As a result, knowledge management is becoming a key factor in meeting the new standards for economic, environmental, and social sustainability.

We aim to improve how we measure the impact of sustainability-focused projects by using better processes and practices that consider environmental, social, and economic factors.

At the 18th edition of IFKAD, we wish to elaborate, extend and improve theories and discuss and share findings, practices and experiences to inform academic, managerial and policy debates about the role of the knowledge drivers in stimulating and supporting the organisational capacity to address the emerging challenges of the sustainability, by

developing and implementing new products and services, re-thought operations, new ways to conceive and use technology and digitalisation, renewed relationships with customers and stakeholders, and new business models.

We invite you to join us in making IFKAD 2023 the premier forum for advancing academic understanding of how knowledge-intensive organizations can address sustainability challenges at all levels of investigation - micro, meso, and macro. Our goal is to provide valuable insights to help leaders, managers, and policy-makers rethink their organizations and develop practical initiatives to move beyond the rhetoric of "greening."

This year's conference program promises to be as informative and engaging as previous IFKAD conferences. With COVID-19 restrictions removed, most attendees will be present in Matera. The conference will feature exceptional keynote speakers who will share their research and practical insights, inspiring new perspectives and avenues of research. Over 200 speakers from 30 countries will present an excellent blend of academic and practical papers.

The IFKAD event in 2023 will demonstrate IFKAD's involvement in Asia through the IFKAD ASIA Chapter, which is led by Prof. Min-Ren Yan from National Chengchi University in Taiwan. In addition, there is a collaboration with Ipàzia, which is a Scientific Observatory on Gender Research led by Professor Paola Paoloni from Sapienza University. The focus of this collaboration is to promote a culture of equality and equal opportunities, while also working to prevent any forms of discrimination or violence.

The IFKAD 2023 conference is a joint effort between the Arts for Business Institute, LUM University, and the University of Basilicata. Our associate partner, the Institute of Knowledge Asset Management, is also involved in organizing this event.

We are honoured for your participation and confident that all the delegates will share insights to help private and public organisations worldwide to face uncertainty, identify opportunities and capitalize on high-level human capital and emerging technologies to improve their value creation capacity.

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Intellectual Capital Framework and Athletes with Disabilities: The Example of Bebe Vio

Roberto Aprile

University of Bergamo
Department of Management
Via Salvecchio 19, 24129 Bergamo, Italy

Susanne Durst*

Reykjavik University
School of Business and Governance
Department of Business Administration
Menntavegur 1, IS-102, Reykjavik, Island

* *Corresponding author*

Abstract

This paper tests the intellectual capital (IC) framework dedicated to elite athletes proposed by Aprile et al. (2022) on the Italian Paralympic champion Bebe Vio to determine the usefulness of this framework and its components. To do so, the study is based on primary and secondary data from and about Bebe Vio. The findings underline that the IC framework offers a solid approach to determine and learn about the IC of elite athletes (regardless of its type). Additionally, the findings indicate areas that could be added/extended to successfully determine the IC of these persons.

Keywords – Intellectual capital framework, Elite athletes, Athletes with Disabilities, Sport, Inclusiveness

1 Introduction

In this paper, we apply the IC framework developed by Aprile *et al.* (2022) dedicated to elite athletes, on the Paralympic champion Bebe Vio (in the remainder of this paper called Bebe, since in Italy she is well known with her first name), an Italian elite athlete (wheelchair fencer), to understand if it can be applied also with reference to the Paralympic elite athletes or if it should be further developed/strengthened to capture different types of elite athletes. Thus, the primary aim is to test the usefulness of this IC framework and its components.

Aprile *et al.* (2022)' framework considers the emerging research interests regarding both sports and elite athletes. As far as the latter is concerned, these types of athletes in particular have an intellectual capital (IC) that allows these individuals to generate considerable monetary capital not only for themselves but also for their immediate environment in the course of their careers (Wicker et al., 2012; Puspitasari et al., 2019), making them an interesting subject of investigation. By focusing on elite athletes, Aprile and colleagues have made an attempt to extend the application of IC frameworks that tend to focus on organizations, industries or countries rather than individual persons (Pedro et al., 2018).

To capture the possible IC of elite athlete, Aprile et al. (2022) propose three specific dimensions namely Natural Capital, Sports Capital and Media Capital. In view of the fact that the framework is still a conceptual work, further research activities are needed to ensure the robustness of the framework and its components. The present paper aims to contribute to this; namely to apply the framework to Bebe Vio.

Bebe has been chosen since she has a very relevant sports capital (she won two Paralympic gold medals) and an impressive media capital strongly related to her contagious energy and positiveness and to her generosity (e.g., she founded an association aimed at helping young amputee people to practice sport, supplying prothesis and other forms of support). By focusing on professional athletes with disabilities we would also like to contribute to bringing more diversity and inclusiveness to social sciences in general and business and management research in particular.

The remainder of this paper is structured as follows. We first briefly address the theoretical background of this paper. We then explain the methodology of the research. This is followed by the application of the IC framework to the case, and finally the discussion and conclusions are presented.

2 Theoretical background

2.1 The IC framework proposed by Aprile et al. (2022)

The IC framework dedicated to elite athletes proposed by Aprile et al. (2022) is based on three IC dimensions namely Natural Capital, Sports Capital and Media Capital. The authors describe Natural Capital as an athlete's natural characteristic; thus, it is assumed that this capital can help the individual to a win and to realize

superior performance not only on the field but also off the field in the form of fame. The sports capital is the sum of sporting success and economic success; i.e., the former leads to the latter while, the media capital aims at increasing the reputation of elite athletes regardless of their sporting successes.

Aprile et al. (2022) argue that elite athletes should invest in these IC dimensions to maximize their success inside and outside the sporting competition zone. According to our knowledge, this framework has not been validated yet, but this would be needed to determine not only the robustness of the framework's dimensions and their elements but also its overall usefulness for determining the IC of highly professional individuals.

2.2 Elite athletes as the focus of studies

The study of elite athletes has intensified over the years given these persons´ impact and influence in different areas of social life (Su et al., 2020). Elite athletes have demonstrated their ability to create enormous incomes from which not only the athlete but also the environment benefits (Puspitasari et al., 2019). The IC of these people is a decisive factor from the beginning of their career to the end, and the more successful the IC, the greater it is (Aprile et al., 2022).

When the studies of elite athletes are examined, it is noticeable that disabled elite athletes are neglected, although they are also very successful on and off the sporting field (Dehghansai et al., 2017a). Erin Popovich (a Paralympic Swimmer), or Esther Mary Vergeer (a former professional wheelchair tennis player) can be named next to Bebe Vio. Important for this study, little is known about the factors that influence the development of athletes with disabilities (Dehghansai et al., 2017b), by taking the perspective of IC and arguing that IC determines and supports the development and maintenance of a successful career, this paper is believed to contribute to this gap in the literature.

A review of the relevant literature reveals that the study of elite athletes from an IC perspective is underdeveloped to date, the focus is still on organizations, and here primarily on private organizations. Thus, the present paper is an attempt to address this situation.

3 Methodology

We used the case study methodology (Yin, 1994; Stake 1995; Miles and Huberman 1994). More precisely, this paper is based on a single case study which

was considered suitable for reaching our aim to test the usefulness of the IC framework. The case of inquiry in this study is Bebe Vio.

To make the testing possible, we collected primary and secondary data. Primary data have been collected through a questionnaire given to Bebe Vio by her father (Ruggero Vio), who is also her manager. To complement and also validate the primary data and vice versa we used the books published by Bebe (2017, 2019) as well as other sources about her publicly available on the internet and traditional media.

The questions were sent by email, following after a conversation with Ruggero Vio that took place in February 2023. The questionnaire was divided into three parts. The first part contained questions aimed at developing a better understanding of the context (e.g., the indication of the victories achieved considered as the most important, Bebe's charitable activities, the main sponsorships and advertising activities, some social networks' data, like number of followers). The second part asked to fill tables containing the three dimensions (natural, sports and media capital) and elements as defined in the IC framework. We also asked for a rating of the individual elements on a scale from 0 to 10. Finally, the third part included some questions about Bebe's opinion on possibly missing elements of the model and others aimed at better understanding the aspects that have mainly contributed to Bebe's success and whether a certain order can be found in the development of the different IC dimensions. The focus of this paper is primarily on the assessment of the individual elements of the three IC dimensions.

3.1 The case: Bebe Vio

3.1.1 The choice of Bebe Vio.

Bebe Vio is the name used by Beatrice Maria Adelaide Marzia Vio Grandis, a wheelchair fencing, specialised in the discipline of foil, born in Mogliano Veneto on 4 March 1997. She has achieved several and continuous sports successes, starting at the age of 15 with the gold medal at the Italian Championship. She started emerging at an international level in 2014, finishing second at the World Cup and at the European Championship. Since 2015, that means since the age of 18, she collected substantially all most important victories in her discipline: from 2015 to 2019, winner of the World Cup, Winner of the European Championships 2016 and 2018, winner of the World Championships 2015 and 2017, and most of

all, gold medal at the Paralympic Games 2016 and 2021. She received important honours such as 'Cavaliere della Repubblica', 'Collare d'Oro Paralimpico' and 'Collare d'Oro' that represent the best Italian awards.

Her notoriety, anyway started before such successes, in fact, since her dream was to participate to Paralympic games, but when she was 15, she hadn't achieved enough sports results to grant the participation at the competition, a journalist, Claudio Arrigoni, indicated to her family that there was the possibility to be candidate to participate at the Ceremony as torchbearer. It was necessary to register on the website of the International Paralympic Committee (IPC) and become the most voted one (Vio 2015, reprinted 2021, p. 21). She was helped to achieve this result from journalists working for an important national Journal (Corriere della Sera) and by the diffusion of the information on several blogs and websites (Vio, 2015, p. 21). Her result was defined 'Overwhelming', since more than 1.000 e-mails were sent to support her application.

She is also notorious for all the charity initiatives that her and her family put in place, in particular by the Association Art4Sport, and for the initiatives aimed at fostering the inclusiveness of athletes with disabilities and able-bodied athletes, in particular with the project 'Wembrace Sport', and with the Bebe Vio Academy, founded in 2021 with the support of the brand Nike. Bebe has some important sponsors – for some of them she is global ambassador – and she connects such partnerships to social projects (diffusion of sport for disables and integration, diffusion of sustainability with the project 'Beyond 0' of Toyota for cars with no emissions, and with Sorgenia, supporting the green energy and the safeguard of women). She is also sponsored by L'Oréal, Barilla, Disney, Unilever.

With reference to the social dimension, she is active in particular on Instagram. Considering all socials in which she is involved, she collects about 2.000.000 followers. She hasn't any social manager. Despite all these aspects, she is reserved, trying to avoid interviews and gossip. She also has some institutional roles and she has had the opportunity to meet the Pope Francesco, the President of the European Commission Ursula von der Leyen, the Italian President Mattarella, and the former President of the US, Obama. She also collected a lot of selfies with famous artists. Her popularity is strongly related to the fact that she is a symbol of correctness, energy, vitality, passion for life, solidarity and other values (defence of the weakest, women and the environment).

Against this background, Bebe was considered an interesting case to be studied, since she combines to an enormous mental strength, a long history of

sports successes (even if she is still very young), and a great mediatic impact, in particular in Italy, but also in several other countries. In other words, one would expect an enormous IC, articulated in each of the three dimensions of the IC framework for elite athletes to be tested in this paper.

4 The application of the IC framework on Bebe Vio

In the following sections, we apply the IC framework for athletes to the case of Bebe Vio. Table 1 displays the framework's three dimensions and their components.

Table 1. Components of IC framework for elite athletes

Natural Capital (Adapted from human capital)	**Sports Capital (Similar to organisational capital)**	**Mediatic Capital (A sort of specific adaptation of relational capital)**
Natural aspects Native characteristics Mental strength/fragility Talent Technical skills Aesthetic qualities Improving elements Training activities Experience	Professional choices Technical choices Other aspects Results Competitions choice Technical staff Professional management Training (place, type, etc.) Coach Team selection Place of training Rest period Lifestyle Relationships with teammates Wins Sport success	Natural aspects Professional choices Other Aspects Reputation Public relations Sponsors (technical and others) Relationships with journalists Social media Media exposition Popularity Sympathetic Empathy Charisma Looks Gossip

Next, we report the assessment of each element of the IC dimensions with reference to the Bebe Vio case. These assessments have been retrieved from the interview.

4.1 Natural Capital

Table 2. Assessment of the elements of Bebe Vio's Natural Capital

Natural Capital Elements	**Degree of importance (0 - 10)**
Native characteristics	3 *(25% of importance)*
Mental strength	10 *(75% of importance)*
Talent	9
Technical skills	8
Aesthetic qualities	8
Training activities	9
Experience	6

4.2 Sports Capital

Table 3 reports the assessments of the elements making the Sports Capital dimension.

Table 3. Assessment of the elements of Bebe Vio's Sports Capital

Sports Capital Elements	**Degree of importance (0 - 10)**
Competitions choice	4
Technical staff	9
Professional management	10
Training	10
Coach	9
Team selection	6
Place of training	4
Rest period	4
Lifestyle	10
Relationships with teammates	9
Wins	10
Sport success	10

4.3 Media Capital

Table 4 reports the assessments of the elements of the Media Capital dimension.

Table 4. Assessment of the elements of Bebe Vio's Media Capital

Media Capital Elements	**Degree of importance (0 - 10)**
Reputation	10
Public relations	10
Sponsor	10
Relationships with journalists	6
Social media	7
Popularity	10
Published Books and other publications	5
Other activities/elements	8

5 Discussion

The analysis of the individual dimensions and element suggests that in terms of Natural Capital, the most important characteristic is mental strength, whereas native characteristics are less important. This is due to the fact that facial disabilities, especially severely debilitating disabilities, require a lot of mental strength. Such disabilities can, of course, reduce many of the physical native features that might characterise an athlete. Talent is important and during the interview it became clear that passion and extreme competitiveness can help to develop sports capital. Technical skills are important and training activity has a high value in the given context. Aesthetic qualities can be important in gaining self-confidence and making the person (athlete) feel comfortable with him/herself and in human relationships.

Referring to the Sports Capital, no great importance has been attributed to the choice of the competition. Bebe focuses only on the most important ones. This is also important to preserve the athlete from injuries. Victories and sports results are considered extremely important. The other elements that are considered most important are (i) having a professional manager, in this case her father, i.e., one who respects the human needs of the athlete without putting economic objectives first. (ii) Training is very important to achieve sports results and absorbs a very relevant part of the athlete's life. Finally, (iii) lifestyle is important both for having the necessary energy for sporting success (those who are happy and motivated can achieve better results) and for Bebe's popularity. The findings suggest that her love for life, the energy that she transfers during her relationships with the people that belongs to her 'squadra', and to other people,

and all her charity initiatives, contribute constantly to Bebe's media capital. Her popularity is the sum of these aspects and enforced by her sports successes. Important is also the choice of the coach, technical staff, and teammates, that means people strictly related to the athlete. Other aspects are considered less important.

As far as media capital is concerned, many of the elements that make it up are closely interrelated. Reputation and popularity are very important. They allow to become the representative of attractive brands. Bebe seems to be a natural when it comes to public relations, since she is at ease with everyone and put at ease people in relationship with herself. Meeting important people increases her popularity even further. Other aspects like publishing books, having relationships with journalists, and social media are not considered as important. Important are, on the contrary, all the charity activities she has put in place because they became one of her distinguishing features.

The result of the interview also enabled a ranking of the three IC dimensions. First and foremost is the Natural Capital, Bebe's mental strength and personality enable her to circumvent significant difficulties and achieve sporting and media success. In 2nd place is the Media Capital, as she became famous before sporting success, as in the case of her participation in the London 2012 Olympics as a torchbearer. Finally, the sports capital has become important and supports the continuous development of her Media Capital.

The analysis of the primary and secondary data also highlighted the important role of the family for the athlete and her development. This is also related to the fact that living with a disability, especially at a young age, requires a great presence and effort from the family. The family, but also friends, are important to cope with this circumstance in order to be able to develop self-confidence as well as the necessary energy, which is important for sporting success. This element was not considered in the tested IC framework. However, it can be considered as another important element that can complement and complete the other IC dimensions. The role of the family also appears important when looking at the careers of other athletes, e.g. Steffi Graf or Raphael Nadal.

6 Conclusions

In this paper, we applied the recently proposed IC framework dedicated to elite athletes by Aprile et al. (2022) on Bebe Vio, an Italian elite wheelchair fencer. The

study helped us to validate the framework and its components. By testing it on an elite athlete with disability we were able to demonstrate that it can also applied on other types of athletes. Additionally, we could expand the framework by adding the family as a further critical element for determining the IC capital of professional athletes. This supplement opens discussions for comparing elite athletes and their operations with those found in family businesses where the role of the family on the firms' success has been studied for many years (e.g., Gomez-Mejia et al., 2001; Salvato & Melin, 2008).

In our view, this study has contributed to a better understanding of the IC framework and its usefulness for determining the IC of individuals (here professional athletes). This was of course only a first step and more research should follow.

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The Impact of Ethical Leadership on KM Practices and Performance

Susanne Durst*

Reykjavik University
Department of Business Administration
Menntavegur 1, IS-102, Reykjavik, Island

Serdal Temel

Ege University, Engineering Faculty, Department of Chemical Engineering
35100 Bornova, Izmir, Turkey

Samuel Foli

Reykjavik University
Department of Business Administration
Menntavegur 1, IS-102, Reykjavik, Island

* *Corresponding author*

Abstract

Considering the relevance of leadership to sustainable business development (Hind et al., 2009; Kurucz et al., 2017; Pham and King, 2019), in this paper, we examine the relationship between leadership and organizational performance. More precisely the focus is on ethical leadership which has been defined as "the demonstration of normatively appropriate conduct through personal actions and interpersonal relationships, and the promotion of such conduct to followers through two-way communication, reinforcement, and decision-making" (Brown et al., 2005, p. 120). Ethical leadership has found to be relevant in situations of change, as followers appear more satisfied with ethical leaders, which in turn motivates them to perform better, engage in more organizational citizenship behaviours, and also enjoy higher job satisfaction (Sharif and Scandura, 2014). A recent study by Ali et al. (2022) has also shown the positive relationship between ethical leadership and organizational learning. At the same time, empirical research on the impact of ethical leadership on organizational performance, however, is still limited (Dey et al., 2022).
Acknowledging the role of knowledge for sustainable business development (Abbas and Sağsan, 2019; Durst and Zieba, 2020), we argue in this paper that ethical leaders will emphasis and promote continued knowledge creation and knowledge networks to

contribute to the firms' organizational performance (Rhee et al., 2022; Li et al., 2009) and thus their sustainable development.
The remainder of this paper is structured as follows. We first briefly address the literature background of this paper. We then explain the methodology of the research. This is followed by the presentation and discussion of the results before we terminate the paper with a conclusion.

Keywords – Ethical leadership, Knowledge management, Knowledge creation, Knowledge networks, performance

Nature of proposed paper - Academic Research Paper

1 Literature background

1.1 Ethical leadership

There is a believe both among practitioners and academics that ethical leadership is crucial, both for increasing the organizational performance of companies (Neubert *et al.*, 2009; Mayer *et al.*, 2009; Treviño *et al.*, 2014) and acting sustainably and responsibly (Islam et al., 2021). It is assumed that ethical leaders are honest and trustworthy (Sosik *et al.*, 2019). Moreover, these persons are described as fair as possible, sound decision-makers and as persons who behave ethically in their professional life (Sharma *et al.*, 2019). Ethics, value, rewards and discipline have been determined as important issues for ethical leadership (Sosik *et al.*, 2019; Koay and Lim, 2019). Such explicit behaviours and traits help ethical leaders to be more reliable, and gets better attention of their team members and motivate them for the common target of companies (Treviño *et al.*, 2000; Treviño *et al.*, 2003).

Moreover, ethical leaders are more human centered and pay more attention on issues such as human rights, self-respect, creativity and they are also motivated to build capacity of employees by providing opportunities and giving them right positions in which they can be successful (Ciulla, 2004; Zhu *et al.*, 2004). They also motivate their team members by providing the right channel to them to build their capacity for better performance. This eventually helps employees to gain knowledge, skills, ability and creativity and to perform better with regard to R&D and knowledge creation activities in return (Al Halbusi *et al.*, 2021). Different works (e.g., Zacher and Rosing, 2015; Jiang and Chen, 2018) revealed that this type of leadership is important for improved knowledge creation performance;

and mainly the ethical leadership promotes this because it supports creativity not only at the individual level but also at the team level (Černe *et al.,* 2013; Chughtai, 2016; Dhar, 2016; Javed *et al.*, 2018) which eventually affects organizational performance (Tu *et al.*, 2018).

Regarding the workplace context, since ethical leaders are critical for employee motivation to gain successful results in the workplace (Dust *et al.*, 2018), they are also considered as the main developer and provider of an innovative atmosphere by motivating and encouraging employees to include learning and creativity activities in companies. Ethical leadership also makes sure that employee's opinions and views are considered during the organizational decision-making process (Piccolo *et al.*, 2010) that increase both the motivation and dedication of employee for the companies. Therefore, we propose the following research proposition:

P1: Ethical leadership has a positive effect on company performance.

1.2 Knowledge management

Knowledge management has been described as a crucial function to contribute to organizations continued and sustained business development (Durst and Zieba). Having access to relevant and updated knowledge is vital not only for ethical leaders (Le and Nguyen, 2023) but also for the employees to make sure that current and coming business opportunities and challenges can addressed (Reinholt *et al.*, 2011).

1.3 Knowledge creation

Nonaka *et al.* (2000, p. 8), have defined knowledge creation as "a continuous, self-transcending process through which one transcends the boundary of the old self into a new self by acquiring a new context, a new view of the world, and new knowledge." Ongoing knowledge creation is relevant to support firm's organizational performance (Li et al., 2009), given that one can also assume that forward-looking leaders will emphasis this process (von Krogh *et al.*, 2011). Goswami and Agrawal (2023) have shown in a recent study the impact of ethical leadership on knowledge creation. Thus, the following propositions are posed:

P2: Ethical leadership has a positive effect on knowledge creation.

P3: Knowledge creation has a positive effect on performance.

1.4 Knowledge networks

It is known that not all knowledge can be developed in-house (Nonaka & Toyama, 2003) and organizations actively enter into networks to get access to new and other knowledge to continuously broaden and deepen their knowledge domains (Durst *et al.,* 2020). Leaders who understand the importance of having access to internal and external knowledge actively promote the creation and maintenance of knowledge networks among employees (Hansen, 2002). Thus, it is assumed that also ethical leaders will actively promote the use of knowledge networks to support the organizations' development and thus their performance (Zhang et al., 2020).

Consequently, the following propositions are raised:

P4: Knowledge creation has a positive effect on knowledge networks.

P5: Knowledge networks have a positive effect on performance.

2 Methodology

2.1 Sample and Data collection

The companies contacted for this research came from the Technology Transfer Office (TTO) company database of Ege University in Turkey. The Ege University TTO was established in 2013 in order to create a link between university and industry as well as help researchers to commercialize their research results. The TTO also has been providing services to companies such as accessing university infrastructures, research capacity and patents. The TTO is playing a key role specially to bring together companies and researchers for contracted research and access to government funds. For these reasons, there is a strong link between the TTO and companies and the TTO has a large company database. To provide sustainable services the TTO registers each company that asks for support into its database. The database contains several contact details of the companies, such as their representatives, sector and company size.

For this study, companies that approached the TTO between 2018 and 2020 for different reasons were selected. There were 1053 companies in total that were contacted. To gather information a questionnaire was developed and sent to the managers of the companies via email. This email was accompanied by a letter that explained the aim of the research. The data were collected between May and

September 2021. Of the 1053 companies, 416 responded to the survey. We excluded missing and non-useful information, i.e., 75 responses were removed that left 341 full responses. This means a response rate of 23%, which can be deemed as good.

2.2 Measures

We used the following measures in our study.

2.3 Independent variables

Ethical leadership: Ethical leadership variable was created by using the 10-item ethical leadership scale developed by Brown et al. (2005). Example items are "my manager listen to what employees have to say", "discipline employees who violate ethical standards". A 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) was used.

2.3.1 Knowledge creation:

To measure knowledge creation four questions were used; example "acquire new/more market knowledge", "acquire new technological knowledge". As before a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) was utilised.

2.3.2 Knowledge networks:

To measure knowledge networks items such as "we form ecosystems" and "generate knowledge together" were used. Again a 5-point Likert was used.

2.3.3 Dependent variable

For measuring performance, we used five indicators namely growth, sustainability, innovativeness, profitability and success. Items were also measured on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

2.3.4 Statistical Methods

Structural equation modelling was carried out test our proposed propositions using the software ADANCO.

3 Results

We conducted several tests in order to assess our measurement model. We checked for the indicator loadings which should be > 0.7 each, which was fulfilled. We checked for reliability / internal consistency using Cronbach Alpha which should be > 0.7, which was fulfilled for each of our variables. We tested convergent validity using the Average Variance Extracted (AVE), scores above > 0.5 are considered as desirable. This was received for all variables but one, knowledge creation obtained a score of slightly below 0.5. namely 0.4805; which, however, was considered still ok by us. Discriminant validity test was also performed to evaluate the level of deviation that possibly exists among the constructs. All indicators had loadings in the accepted thresholds.

We also investigated collinearity among our indicators and found that all variance inflation factor (VIF) values were below 5 which indicates that there is no indication of problematic multicollinearity. The values for the indicators ranged from 1.2188 to 2.2568.

In order to evaluate the structural model, we examined the overall fit of the estimated model, the path coefficient estimates, their significance and, the effect sizes (f^2) and the coefficient of determination (R^2) (Benitez *et al.*, 2020). The results show a good SRMR index (0.0725), a measure of approximate fit, below the suggested threshold of 0.08. The path coefficient estimates for our proposed relationships range from 0.093 to 0.589, and are significant at a 5% significance level except the effect of the relationships between knowledge creation and performance and knowledge networks and performance. The evaluation of the effect size (f^2) revealed values ranging from 0.0063 to 0.5313. Values larger or equal to 0.350 indicate large effect size, in our case reached for the relationship between knowledge creation and knowledge networks while values below 0.150 indicate weak effect size (Benitez *et al.*, 2020), which was obtained in our study for the relationships between ethical leadership and performance, knowledge creation and performance, and knowledge networks and performance. Finally, we evaluated the R^2 and learned that our model explains 14.54% of knowledge creation, 34.70% of knowledge networks and 11.56% of performance.

The results of the propositions testing are presented in Table 1.

Table 1 Propositions testing results

Effect	Path coefficient	Mean value	Standard error	t-value	p-value (one-tailed)	Interpretation
Ethical leadership -> Performance	0.2013	0.2144	0.0912	2.2061	0.0138	Accepted
Ethical leadership -> Knowledge creation	0.3813	0.3949	0.0764	4.9900	0.0000	Accepted
Knowledge creation -> Performance	0.1381	0.1351	0.1149	1.2022	0.1148	Rejected
Knowledge creation -> Knowledge networks	0.5890	0.5905	0.0785	7.4991	0.0000	Accepted
Knowledge networks -> Performance	0.0925	0.0951	0.1285	0.7200	0.2359	Rejected

4 Discussion and conclusion

Our findings allow us to better understand the link between ethical leadership and performance. The findings confirm recent research that stressed the pivotal role of ethical leadership for organizational performance (Tu *et al.*, 2018; Dey *et al.*, 2022). Additionally, the findings suggest that ethical leadership significantly influences both knowledge creation and knowledge networks in organizations. We provide empirical evidence about the impact of knowledge creation and knowledge networks on performance and thus add to recent research in these areas (e.g., Zhang *et al.*, 2020; Goswami and Agrawal, 2023).

Our study contributes to both the body of knowledge concerning leadership and KM; empirical research on ethical leadership in conjunction with KM has only started recently and is still rather fragmented (Le and Nguyen, 2023). Having a better understanding of the link between ethical leadership and performance has important managerial implications for decision-makers in organizations too as it can help them to make better (i.e., more informed) decisions regarding the training of ethical leaders and their role in improving KM and thus ultimately organizational performance.

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Knowledge Risks Arising from Digitalization

Malgorzata Zieba*

Department of Management
Faculty of Management & Economics
Gdansk University of Technology
ul.Narutowicza 11/12, 80-233 Gdansk, Poland

Susanne Durst

Department of Business Administration
Reykjavik University
Menntavegur 1, 102 Reykjavík, Iceland

Department of Business Administration,
School of Business and Governance,
Tallinn University of Technology,
Ehitajate tee 5, 19086, Tallinn, Estonia

Martyna Gonsiorowska

Doctoral School
Gdansk University of Technology
ul.Narutowicza 11/12, 80-233 Gdansk, Poland

** Corresponding author*

Abstract

This conceptual paper aims to identify and analyse knowledge risks resulting from digitalization. Additionally, the paper tries to present factors influencing knowledge risks arising from digitalization and ways of handling them.
The study is a continuation of the research by Durst and Zieba (2019) related to knowledge risks and their potential outcomes. This present study makes an update on the literature on knowledge risks arising from digitalization.
The paper offers new insights for researchers dealing with the topic of knowledge risks in the context of digitalization and ways of handling them.
The study provides insight for each of us, as the issue addressed concerns us all. By becoming aware of the potential consequences of such knowledge risks, people may meet and cope with digitalization in a better, more enlightened way.

The presented paper is based on prior literature and the authors' reflections, experience, and analysis. Thus, to check for the suitability of the risks proposed, there is a need for empirical studies. Such studies are planned by the authors in the near future.

Keywords – Knowledge risks, risk management, knowledge management, digitalization

Nature of proposed paper - Academic Research Paper

1 Introduction

The dynamic development of the past (the recent one in particular) has made the importance of knowledge for organisations and people in general even more evident. From the beginning of the study of knowledge management (KM), knowledge had been both presented and examined as something positive that has to be collected, stored, transformed and broadly shared within organisations (Nonaka and Takeuchi, 1995; Massingham, 2010; Durst and Edvardsson, 2012). Only recently, this approach has been questioned by the increasing focus on factors that can potentially bring negative risks and challenges related to knowledge. The whole plethora of so-called knowledge risks has been identified (Durst and Zieba, 2019) and organisations too have started to consider them in their regular activities related to knowledge management (Durst et al., 2019; Marabelli and Newell, 2012; Sarigianni et al., 2015). In the taxonomy proposed by Durst and Zieba (2019), there are three main categories of knowledge risks namely human knowledge risks, technological risks and operational risks. Among the technological risks, one can find risks related to cybercrime, old technologies, digitalization, or social media (Durst and Zieba, 2019). In this paper, the authors are going to examine in more detail one type of those risks, namely knowledge risks resulting from digitalization. As the world becomes increasingly interconnected - a development that started even before the pandemic but accelerated it - it is crucial for all types of organisations to also address the possible negative impacts of this development. To the best knowledge of the authors, however, there are no studies examining knowledge risks related to digitalization, thus there is a clear need for rigorous research on the topic.

To fill this knowledge gap, this conceptual paper identifies and analyses knowledge risks resulting from digitalization. The paper develops in the following way. In the second part, it presents the concept of knowledge risks. In the third section, digitalization and risks related to it are described. In the fourth section,

knowledge risks arising from digitalization are presented, alongside with factors influencing them and ways of handling them. The last section concludes the paper.

2 The concept of knowledge risks

Perrott (2007) defined knowledge risk as the likelihood of any loss resulting from the identification,

storage or protection of knowledge that may decrease the operational or strategic benefit of a company. While Durst and Zieba (2017) in order to highlight the possible origin of knowledge risks divided them into internal and external knowledge risks. According to these authors, internal knowledge risks are primarily connected with an organization's internal environment and cover risks such as knowledge attrition, knowledge waste or knowledge hoarding, while external knowledge risks can emerge due to an organization's interactions with its external environment, examples of these risks are knowledge leakage or knowledge spillover. Durst and Zieba (2019) developed a powerful taxonomy of knowledge risks, realized in the form of a knowledge risk map, that classifies knowledge risks according to three categories: operational, human, and technological. Human knowledge risks are connected with the employees, organizational culture, social and psychological factors. Possible knowledge risks are knowledge hiding, unlearning, or missing competencies. Technological knowledge risks are related to the usage of different information and communication technologies (ICTs), and their consequences. It covers cybercrime, digitalization or social media risks. While the last category operational knowledge risks is about the organization’s functioning and its daily operations. It includes knowledge acquisition and application risks, or risks related to the knowledge gaps.

Major knowledge risks if not addressed properly can result in several negative consequences, such as failing to offer high-quality solutions (Demian & Fruchter, 2009), costly disruptions of performance or operations (Martins & Meyer, 2012) or reduced capacity to innovate (Durst et al., 2018).

3 Digitalization and risks related to it

Digitalization is more than just technical development or digital transformation. It is defined as “socio-technical phenomena and processes of adopting and using

digital technologies in broader individual, organisational, and societal contexts." (Legner et al., 2017). It originated as the automation of routine work, the next wave of digitization gave rise to e-commerce, and the Internet became a global communication infrastructure. Today the vision of universal computerization is no longer distant, it is very close to being realised. The current wave of digitalization is affecting human lives at all levels (Legner et al., 2017). Certainly, it brings people many benefits every day, it improves the company's results, reduces costs, strives for new products, and provides ever-new customer experiences (Savic, 2019). Nevertheless, organisations and societies have not mastered the ability to follow and adapt to digital changes. Pearce (2020) reveals that even boards of directors are not well prepared and lack the competencies to govern digitalization incentives, especially as it brings ever newer challenges and risks. Additionally, the pandemic in 2020 had accelerated the digitization process and brought additional challenges. Not all companies were ready in terms of financial resources or simply time to properly adopt and use digital technologies in the organisational context (Almeida et al., 2020). At that time, companies and societies felt tremendous pressure to digitise quickly, but the obstacle faced was the inexperience of many. The challenge was not just buying technology, digitization is about introducing new technology in such a way that it is adopted and becomes an integral part of the new reality that increases efficiency. Not all companies had the right conditions to successfully carry out this process (Almeida, 2021).

The adverse effects of accelerated digitization are being felt by everyone. Concerns have begun to arise that a less educated population unfamiliar with digital technology will begin to lose their jobs. Even those with skills may begin to fear that they will soon be replaced by intelligent machines. This harms society, arousing a kind of negative emotions, and an aversion to rapid digitalization. People are afraid of losing their autonomy, and thus their motivation to work may decrease (Gimpel & Schmied, 2020). Another side effect could be a deterioration in interaction and cooperation between people, whether friends, family, or co-workers. In a way, people are isolating themselves, hiding behind the screens of digital devices, while cyberbullying is gaining momentum. Another risk or side effect associated with digitalization is an increase in vulnerability to cybercrimes and thus their more frequent occurrence. National reports are sounding the alarm about this phenomenon. For example, Denmark, a leading country regarding the level of digitalization, is at the same time facing a very high risk of cybercrime and cyber espionage (Danish Centre for Cyber Security, 2021). Polish companies have

also increased digitization initiatives in recent years. The driver for the change was the need to reorganise the workforce in the pandemic. As a consequence, more than half of Polish companies noticed an increase in vulnerability to cyber-attacks, and as many as 64% of them reported at least one cyber security incident in 2021 (Cyfrowa Polska, 2021). This example discloses that the pressure to keep up with technological changes is high, but to have pressure or even awareness of cybercrime is not enough for companies and societies to be adequately prepared. It seems that the pace of digitalization is faster than the pace of spreading the necessary knowledge and skills to cope with it. Moreover, this lack of competencies does not only affect individuals but also small and large companies. Even though the larger companies often have specialised IT departments, it was reported that 55% of large companies worldwide are unable to effectively stop cyber-attacks (Cyfrowa Polska, 2021). To sum up, although digitalization brings many positive phenomena, it also has some negative consequences and causes some risks for organizations and individuals. Deloitte has prepared a framework that covers 10 areas of digitization risk which are present in every digital environment (Deloitte, 2018). Additionally, Gimpel and Schmied (2020) identified and described 11 types and 35 subtypes of risks and side effects of digitalization. It can be said that the general risks associated with digitization are well described in the literature. However, there are many knowledge risks arising from digitization, while literature linking digitalization and knowledge risks is very scarce. Durst and Zieba (2019) have only generally mentioned digitalization as one of the knowledge risks in their previous studies. This constitutes a research gap, and there is a need to take a closer look at knowledge risks arising from digitalization.

4 Knowledge risks arising from digitalization – factors influencing them and ways of handling them

In this section, the authors of this paper list potential knowledge risks resulting from digitalization followed by factors influencing these risks and potential countermeasures for dealing with them.

The first potential knowledge risk resulting from digitalization are related to **mental health issues**. Digitalization can adversely affect individuals' mental health and contribute to knowledge loss/unlearning. Employees might feel overwhelmed with digitalization and as a result, not cope with it in their everyday

work. Employees not being in their best mental state might have problems with motivation to work, take sick leaves more often and manifest some negative phenomena related to knowledge, such as knowledge hiding or knowledge hoarding.

The second potential linked knowledge risks connected with digitalization is **the loss of autonomy** and **lack of empowerment**. Digitalization can lead to a loss of the ability to make one's own decisions, a feeling of lacking power among employees and as a result, a reduced engagement in activities related to knowledge sharing and creativity . Empowerment is a vital element of an organizational culture of trust and learning (Caniëls *et al.*, 2017) and when it is missing, employees are less eager to admit to mistakes or come up with innovative ideas.

The third potential knowledge risk related to digitalization is **the dehumanisation of work**. For example, digitalization brings job losses and the need for new occupations, which can lead to the dropout of some valuable employees and their knowledge from organizations. Possible consequences of this situation could be a motivation problem among workers across generations and their tacit knowledge is also likely to suffer.

The fourth knowledge risk is the **overreliance on technology** leading to wrong or improper decisions - based on automatization without the human factor inclusion trivial and biased decisions might be made.

The fifth knowledge risks is **vulnerability**. Companies of all sizes run the risk of having nothing to defend themselves against possible cyber-attacks. In the worst case, there is a threat of the cessation of business activities.

A last but not least knowledge risk is **acting rashly**. The fast and increasingly unpredictable development can lead to rash actions out of fear of missing something / losing the connection. Digitalization brings the pressure on organizations to adapt quickly and with the use of new technologies. Those technologies might not be suitable or stable enough to use in an organization, but organizations might feel pushed to implement them.

There are several factors that may potentially influence the knowledge risks described above. Those factors can be divided into two groups: human factors and technical factors.

Human factors:

1. ways of implementing digitalisation solutions and skills in change management manifested by the management staff (e.g., leadership

support) - for example, if employees are trained, involved in the process of digitalisation process from the beginning, supported, etc., they may more easily accept it and the knowledge risks like mental health issues can be reduced;

2. part/share of the processes that are substituted with digitalisation - to which extent the regular routines and habits of employees will be affected by digitalisation and how well this is explained/justified to employees – if employees understand why it is necessary and how it will help in their work, they will feel more empowered;
3. creating organizational culture of trust – if employees trust their supervisors and peers, they will be more eager to accept digitalization process and its consequences;
4. faith in technology – if employees have faith in technology and are aware of both the positive and negative benefits it may bring, they will be more open to the whole digitalization process.
5. skills and competences of the organization members – if the organization members are constantly being trained or educated with regard to risk management, knowledge management and digital transformation, the likelihood that they will approach the topics in a more informed and reflective way increases.

Technical factors:

1. solutions and their suitability for the organisation/industry/sector – if the solution is suitable and adjusted to the needs of an organization, it can boost the operations and gain the acceptance of employees, otherwise, it is more probable to be a failure;
2. necessary upgrade of the solutions - how often, how it is going to be handled technically, etc. – the more complicated and frequent the updates need to be, the more difficult it will be to sustain the solution in the organization and get the support of employees;
3. digital readiness of the organization – if the organization is not ready technically and organizationally, implementing digitalization process will be hindered.

To sum up, there is a variety of knowledge risks arising from digitalization that may potentially hinder the operations of an organization. Their consequences might be negative for the organization and its individuals. Essential knowledge risks if not addressed can terminate the business. All in all, knowledge risks arising

from digitalization should be taken into consideration and their consequences should be minimized as well as possible. Otherwise, they risk significantly reducing the performance/well-being not only of the organisation but also of the people.

Apart from these above knowledge risks resulting from digitalization, there are many risks in general. For example, there is a threat of even stronger discrimination against minorities. There is clear evidence that the programming of the algorithms is significantly influenced by the person behind it (Orwat, 2020). Since these jobs are still run by men, there can be considerable negative effects in different areas of life, e.g., in granting loans, in the job application process, etc. Digitalization can also lead to marginalised social groups. The changes risk exacerbating the digital divide, and people with low education and from poorer countries will suffer even more (Vasilescu et al., 2020). The above discussion also shows how important education, training and continuous professional development are. This must begin as early as possible, for employees to be trained and understand the whole digitalization process better. The state, but also each individual, has a decisive role to play here.

5 Conclusions

This conceptual paper has identified and presented different types of knowledge risks arising from digitalization. Focusing on knowledge risks analysed in the context of digitalization, the taxonomy roposed by Durst and Zieba (2019) has shown again its powerful usefulness for different settings and challenges. From a practical point of view, the study provides useful insight for each of us as the issue addressed concerns us all. Becoming aware of the potential consequences of such knowledge risks, people may meet and cope with digitalization in a better, more enlightened way.

The limitations of this paper are similar to those of theoretical or conceptual papers. The presented paper is based on prior literature and the authors' reflections, experience, and analysis. Thus, to check for the suitability of the risks proposed, there is a need for empirical studies. Such studies can be conducted in the near future.

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Knowledge Management and Metatheory in a BANI World

Yasmina Khadir

Centre of Strategy, Organization and Leadership
Nyenrode Business Universiteit
Straatweg 25 - 3621BG Breukelen
The Netherlands

Abstract

The purpose of this paper is twofold: (1) to understand how knowledge management failed to fulfil its promises and became a blurred field of research that gets increasingly diluted in adjacent fields, a catch phrase referring to an eclectic group of intangible phenomena related to learning and roughly to any organizational situations using the word 'knowledge'; (2) to explore how the use a meta-theoretical analysis may suggest a way forward that moves away from eclectics to unity and highlight the potential KM holds for organizations striving to manage organizational knowledge within turbulent times. Considering the persistence of the conventional rational-cognitive obsession with recipes and the slicing and dicing of organizational knowledge in well-defined, circumscribed, and quasi-observable sub-domains, is timely. This widely spread inclination in objectifying and reifying knowledge fails to help organizations navigate the complex business environment of this first quarter of the 21st Century. Contemporary organizations are compelled to manage knowledge within a VUCA or BANI world. More than ever, firms must consider holistic perspectives enabling the management of an ambiguous and elusive organizational knowledge, while acknowledging the complexity or crisis state of our current world. Practitioners and scholars must go beyond the simplified assumptions currently available in mainstream literature. The following research question guides the study: What does a meta-theoretical study about the evolution of knowledge management reveal on its inherent ontological and epistemological assumptions, and how can this support scholars and practitioners to make most of a VUCA context? Through a meta-theoretical analysis, this paper endeavours to highlight how the field has come to this situation. It attempts to refocus the audience attention on the kernel of organizational knowledge, mechanisms, and dynamics. Meta-theoretical analyses on knowledge management are rare provided that the field is taken for granted and that trends seems to define the field and how it evolves.

Keywords – Knowledge management, Metatheory, Positivism, Social Constructionism

Paper type – Academic Research Paper

1 Introduction

The purpose of this paper is twofold: (1) to understand how knowledge management failed to fulfil its promises and became a blurred field of research that gets increasingly diluted in adjacent fields; (2) to explore how the use a meta-theoretical analysis may suggest a way forward that moves away from eclectics to unity and highlight the potential knowledge management holds for organizations striving to manage organizational knowledge within turbulent times. In other words, this study attempts to highlight some problems that may jeopardize the future of knowledge management and provide some prompts for a much-needed philosophical discussion.

Although, questions may arise on the importance of knowledge management, it is unquestionably viewed as part of the organizations' picture today (O'Leary, 2016). Practitioners identify knowledge management, the activity of identifying and leveraging the collective organizational knowledge helping an organization to improve its competitive advantage (von Krogh, 1998), as one of the top three domain affecting companies' success. This role has become even more prominent since the last pandemic as employees work from different locations (Behme and Becker, 2021). In research, knowledge management has become a full-fledged field of research (Bedford, 2013) despite its many eclectic definitions (Alavi and Leidner, 2001). In 2018, an international standard on knowledge management has been published by the International Standards Organization (ISO), giving knowledge management the legitimacy the field deserves as 'a distinct, strategic and influential management practice' (Loon, 2019: , p. 433). Thus, knowledge management has achieved a certain maturity and a substantial body of knowledge has accumulated for the last 30 to 35 years allowing a sound reflection of the paradigmatic evolution of this science.

However, the field has not really achieved its potential and is crippled by a lack of conceptual robustness (Serenko and Dumay, 2015b; Tzortzaki and Mihiotis, 2014). Rather, knowledge management has evolved into a convenient phrase, gathering different processes (Gaviria-Marin et al., 2019; Alavi and Leidner, 2001). Adding to the confusion, KM is sometimes combined with the resource-based view of the firm theory (Audretsch (Audretsch and Belitski, 2021). Looking back at the consolidation of knowledge management since inception, it is worth considering the times where knowledge management emerged and developed or when its overall reason of being and future are questioned. Such complicated

business contexts have been labelled as a world characterized by volatility, uncertainty, complexity, and ambiguity (VUCA) (Bowman, 2019; Bennet and Lemoine, 2014). Some argue that the Covid-19 pandemic and its aftermath made VUCA an insufficient descriptor and use an alternative acronym to refer to the present turbulent time: BANI. (B) B stands for Brittleness and the ideas that business stand on fragile foundations that can collapse anytime and overnight. (A) Anxiety characterises our society at large and a sense of urgency guide decision-making. (N) Detailed and long-term planning organizations depends on, is no longer possible in a Non-linear world where events appear disconnected and disproportionate. (I) The final letter underscores an Incomprehensible world where individuals seek for answers, but these answers do not makes sense; so at the end, actors must understand that the don't have to control everything (Cascio, 2020; Adam, 2023). While the 1990s introduced the game changing Internet and workflow software (Friedman, 2006), the 2020s brought about the trend that has been building for subsequent 30 years at full speed with the Covid-19 years, the Artificial Intelligence (AI) being the new disruptive technology (Akinsola et al., 2022).

Against a backdrop of 'turbulent times' acknowledging the complexity or crisis state of our current world (Bratianu, 2020), this paper aims to underscore the need to restart or rather engage in a metatheoretical discussion about knowledge management, and how it has consolidated over the last 30 years. Metatheory can be viewed primarily as "the study of theory, including the development of overarching combinations of theory, as well as the development and application of theorems for analysis that reveal underlying assumptions about theory and theorizing"; in short the central subject of study is theory (Wallis, 2010, p. 78). Any piece of research builds on a particular ontology (i.e., the reality out there), epistemology (i.e., ways of knowing or the relationship of the knower with that reality, and a methodology (i.e., what method the knower is using). Beyond, one must look at the bigger picture and reflect on the techno-economic paradigm (i.e., the economic, social, and technological context) (Perez, 2010) within which a theory is born and evolves. Provided that every researcher's production holds somehow to these assumptions, they adopt a specific metatheory or philosophy of science (Sousa, 2010). The following research question leads the paper: *What does a meta-theoretical study about the evolution of knowledge management reveal on its inherent ontological and epistemological assumptions, and how can this support scholars and practitioners to make most of a VUCA context?*

An attempt to answer this question called naturally for a literature review analysis that would have focused on identifying existing ontologies and epistemologies and see how the field had evolved since inception, or rather the 1990s. However, such an attempt revealed of limited interest for two reasons. First, several recent literature review studies have been recently executed in the field of knowledge management (Durst et al., 2023; Farooq, 2021; Serenko, 2021; Agostini et al., 2020). These studies covered many dimensions of the knowledge management literature. Second, the pointed to the very limited contributions to metatheories (Serenko and Dumay, 2015a; Agostini et al., 2020; Serenko, 2021). Instead, to provide a better account of the emergence of the philosophy underpinning knowledge management, we relied on Barley et al. (2018) bibliometric study published in the Academy of Management Annals, a highly ranked journal.

Hereafter, we provide background information on Barley et al. (2018) approach. The authors made the choice to start the study of papers with the year 1996, the year when the special issue from Strategic Management Journal on Knowledge and the firm was published (Spender and Grant, 1996). Their study focussed on knowledge management at large and used key terms (e.g., "knowledge management", "knowledge sharing", "knowledge transfer", etc.) encapsulating diverse dimensions of knowledge management, view that is in line with what this paper seeks to address. Then, Barley et al. (2018, p. 281) identified the papers that were the most cited per year and retained the top 10 ones; the sample expresses a primary interest "in examining the processes by which knowledge flows within organizational contexts.") Within the groups of papers selected for the year 1996, the ones including a discussion on epistemology and that are highly cited, are retained for points of reference (e.g., Grant, 1996; Spender, 1996; Kogut and Zangler, 1996). Other papers such as Mowery et al. (1996) or Sanchez and Mahoney (1996) are discarded as they do not engage in metatheoretical discussion. To provide a fuller picture, other highly cited texts such as Nonaka and Takeuchi (1995) are considered. This paper is laid out as follow. First, against a techno-economic backdrop, we discuss how knowledge management emerges around the mid-1990s and we put forwards the needs for a knowledge-based view of the firm theory for the 2020s. Second, we provide a critical review of positivism and social constructionism, two favoured approaches in knowledge management. Then, considering the techno-economic context of the 2020s, we suggest some possible ways forward.

2 Some considerations about knowledge management in recent history

Although the last three decades seemed to be an epoch marked by a succession of extraordinary (as in out of the ordinary) events, the 1990s (Friedman, 2006) and the current times, the early 2020s (Loon, 2019) as two interesting milestones that can be characterized as 'turbulent times'. These dates are not proposed as the ultimate turning points of modern socio-economic history and its impact on organizations, but these years coincide with maturity points for knowledge management.

Although Simons'(1947) critique of economic rationality and Edith Penrose's work may be considered as the origin of knowledge management, the first manifestations can be traced back to the early 1970s with Henry (1974) introducing the central role knowledge principles play in public policy and major companies such as Chaparral Steel (Leonard-Barton, 1995) and Digital Equipment Corporation putting actually setting and implementing knowledge management (Wiig, 1997). But, as bibliometric studies show (Farooq, 2021; Mariano and Ykika, 2016), momentum for knowledge management is gathered when the substance of our modern economies changed at the turn of the 1990s and the advent of the knowledge societies (Bell, 1973; Drucker, 1993; OECD, 1996). A new techno-economic paradigm (Perez, 2010) emerges signalling the importance of the world of intangibles over the tangible (OECD, 1996). The previous industrial age is a brick-and-mortar era where land, capital and labour represent the core elements of value creation. Large corporations, such as major car manufacturers, big banks, and the likes, constitute formidable pillars on which our modern world is built. Progress is made in academia and a humanistic approach of organizations take form (Cohen et al., 1972; March, 1978; Schein, 1985; Weick and Roberts, 1993).

In the 1990s, the emergence of disruptive technologies such as the Internet and workflow software, the advent of geopolitical upheavals such a globalization and the rise of BRIC countries (Dicken, 2015; Friedman, 2006; Reich, 2002), and the acknowledgement of knowledge-intensive firms (Sveiby and Lloyd, 1988; Starbuck, 1992) signalled a profound change in the nature of business contexts. The convergence of different forces indicate the emergence of a new era, an era where the intangible became the main source of organizational performance (Carlucci and Schiuma, 2006). This VUCA world set the tone for the rising knowledge age. Against this backdrop, scholarly contributions on knowledge

management emerged and formed the base of the field that was to develop in the three following decades. In the same period, some key contributions to knowledge management are published, for example Kogut and Zander (1992); Nonaka and Takeuchi (1995). For example, Grant (1996) seminal paper introduced knowledge integration mechanisms for organisations while Spender (1996)'s conducted an epistemological inquiry about knowledge differentiation and it dynamics; Nonaka (1994) gifted the field with the most complete theory of knowledge so far (Krogh et al., 2013). knowledge management was then celebrated with the special issue of Strategic Management Journal on Knowledge and the Firm (Spender and Grant, 1996).

The 2020s are the years where knowledge management is part of the International Standard Organization benchmarks. This period is also marked by intense social (i.e., global social movements against inflation, authoritarian political orientations; development of working from home), technological (i.e., advent of AI since November 2022; cybersecurity issues), and economic turmoil (i.e., near bankruptcy of Credit Suisse; bankruptcy of Silicon Valley Bank, inflation). Thus, both the 1990s and 2020s two periods conveniently represent two points of references allowing us to engage in a meta-theoretical study of knowledge management. Indeed, while the 1990s trumpeted the need for a knowledge-based view of the firm, the 2020s renew this imperative.

Wallis (2010) argues that the traditional approach existing in social sciences consists in committing expensive resources to the problem studies and that this led to the emergence of thousands of theories and vast amounts of data. The author blames this on the imitation attempts made after physical sciences where scientists became mostly concerned with gathering objective facts (see also Tsoukas, 2016) through empirical research, downplaying the importance of delineating or identifying a clear theory. For example, a study shows that 61% of academic papers published between 1997 and 2009 did not apply any theory (Serenko and Dumay, 2015a), trend that should be worrying. This metatheoretical 'noise' is clearly present within knowledge management. Recent studies provide a mapping of knowledge management and give an account of the many facets of the discipline encountered in the literature in the last decades. For example, Barley et al. (2018) reviewed 20 years of scholarly contribution and uncovered a bias towards knowledge integration over knowledge differentiation and its processes. A bibliometric analysis conducted by Farooq (2021) over 35 years of literature shows that knowledge management is at the centre of knowledge

management itself, innovation, performance and learning. We can see that each different bibliometric study provides an interesting account of what is going on in the field and what aspects of knowledge management is occupying researchers' minds, which seems to shy away from metatheoretical concerns.

While some scholars strive to bring unity in the field suggesting more nuanced understanding of knowledge management (Agostini et al., 2020; Akbar, 2022), others simply propose to abandon any notion of interdisciplinary cohesion and consistency and that knowledge management should be viewed as an overarching umbrella that gather divergent schools of thought (Serenko, 2021; Schultze and Stabell, 2004). In this paper, we lean against the former and rather support the idea that knowledge management is crippled with a lot of confusion, disintegration, and sharp divides (Spender, 2013; Spender, 2015; Pereira and Bamel, 2021). There is little efforts to address this unfortunate situation based on the small number of papers addressing these paradigmatic issues, number that seem to be decreasing further (Serenko, 2021; Spender, 2015).

The way KM exists and how it has evolved, does not allow a holistic nor integrative view of organizational knowledge-related activities as this was originally suggested (Spender, 1996; Nonaka and Takeuchi, 1995). Instead, KM became like a Swiss knife and resembles a collection of recipes made available to organizations to fix punctual problems. This presents the advantage of diversity of options and of the easy use quick fixes provide. The problem with this, is that managing knowledge remains superficial and does not transform the organization in depth, or at least does not affect the way managers are thinking about organizational knowledge. Indeed, the Newtonian philosophy within which our organizations and management studies are based is deeply rooted in practitioners and scholars' minds alike (Tsoukas, 2016). We argue that the lack of uniformity in the field is rooted on the lack of metatheoretical discussion that is too often the case in management and organizational studies (Sousa, 2010; Tsoukas, 2016), and that the knowledge management as a field is crippled by prevailing positivist and social constructionist epistemologies (Reihlen and Ringberg, 2013; Ringberg and Reihlen, 2008).

3 Consolidation of the knowledge management paradigm

3.1 Few words on positivism and its limitations

The favoured philosophy in research in general and in the field of knowledge management in particular pertain to positivism (Sousa, 2010). This perspective is the at the centre of knowledge-based view of the firm (Grant, 1996; Kogut and Zander, 1992; Conner and Prahalad, 1996) and the resource-based view of the firm (Barney, 1991; Wernerfelt, 1984). Ontologically, knowledge is considered an external and objective entity, an object that can be transmitted or exchanged outside any human intervention (Orlikowski, 2002; Nag and Gioia, 2012). More recently, Foss (2003) extended the transaction cost economies to knowledge management and likened knowledge to information and a commodity one could exchange outside any cognizant mind. Around 2000, this trend was strengthened by the rise information technology and the myth that human knowledge could be traded and shared outside the knower. Moreover, Alvesson and Kärreman (2001, p.1007) argue that "it is assumed that stored knowledge provide templates for thinking as well as acting". This means that positivist researchers make sense of the word or symbol independently from the mind of the one perceiving it (Ringberg and Reihlen, 2008). At this point, one must take in consideration the domination of positivism in management and organization studies (Tsoukas, 2016) and in the field of knowledge management. Afterall, the knowledge-based view of the firm concept is seen as an 'outgrowth' of the resource-based view of the firm (Grant, 1996).

At the turn of the 1990s and the call for handling intangible knowledge, many scholars expressed critical views about a positivist approach of knowledge management. For example, Spender (1996), in his influential paper entitled 'Making knowledge the basis of a dynamic theory of the firm', has presented several limitations of such a metatheoretical approach and an objectification of knowledge. Nonaka and Takeuchi (1995), Blackler (1993) among others had underscored that knowledge cannot be separated from the knower (Alavi and Leidner, 2001; Tuomi, 1999) and called for a different philosophy. In a study on computer-mediated knowledge management systems, Reihlen and Ringberg (2006) showed that individuals' understanding and interpretation always determine knowledge artefacts. Interestingly, positivists blame people's "limited absorptive capacity rather than divergent interpretative frameworks" (Ringberg

and Reihlen, 2008: , p. 915). For positivists, texts is a mean that carries objectified meaning (Boland et al., 1994), statement that lead Whorf (2012) to argue that positivists choose to ignore the beautiful intricacies composing complex systems of linguistic patterns and classification two ends of a communication must share prior adjusting to each other's assumptions. Thus, positivists view knowledge as a product that can be easily stored, accessed, and widely disseminated (Sousa, 2010). This raises some questions then: can we share knowledge without creating it beforehand? Can we create knowledge without some kind of pre-existing repository? Can we disseminate (for whatever this entail) knowledge without any of these steps? Although the practitioners' concern attached to any of these knowledge slices is understandable, it merely shows that assumptions are made that knowledge issues can be approached in a compartmented manner like an object that can be decomposed, laid bare into its basic components, ignoring the knower.

3.2. Few words on social constructionism and its limitations

Other philosophical approaches are found in knowledge management, approaches that strove to best embrace the intangible resources organizations needed to harness. For social constructionists for example, knowledge emerges from socially constructed processes and is expressed or enacted through practice, approach used to understand knowledge transfers of organizational conflicts (Brown and Duguid, 2001; Orlikowski, 2002; Tsoukas and Mylonopoulos, 2004) or collective knowledge (Paraponaris and Sigal, 2015; Brown and Duguid, 2001). In other words, for social constructionists, knowledge is formed and transferred through practice. In their seminal text, Nonaka and Takeuchi (1995) made clear that tacit knowledge should be made explicit in to be transferred to the rest of the organization and participate in setting the tone for knowledge management.

This approach also presents issues. Some argue that social constructivism follows a pattern that is very similar to positivism and that practice instead of texts are the carriers of objectified meaning. At the end, both knowledge production and knowledge transfer are codified and are separated from the knower (Ringberg and Reihlen, 2008). This obsession viewing knowledge as an object is an odd contradiction. While knowledge is viewed as the most strategic resource a firm possess (Quinn, 1992), resource that is idiosyncratic, not easily

transferable or replicable (Grant, 1996), knowledge management researchers strive to make this strategic asset explicit (Schultze and Stabell, 2004).

4 Discussion and conclusion

Two popular metatheories in research were briefly introduced, both presenting different world view but ending with similar outcomes, the objectification of knowledge and its Newtonian treatment (e.g., Van den Berg, 2013, Akhavan et al., 2018). We argue that such approaches do not help knowledge management progress or make for its own name. We argue that the field is in danger of disappearing or being absorbed by neighbouring fields such as organizational learning (Akbar, 2022; Castaneda et al., 2018; Trigo, 2013; Massingham, 2020). No matter the statements made influential scholars (e.g., Spender, 1996, Nonaka and Takeuchi, 1995, Cook and Brown, 1999), the philosophical principles underpinning positivism and social constructivism alike, the separation between knowledge and the knower, still prevail like the many papers on knowledge-sharing or knowledge transfer show (Haas et al., 2015; Zhou and Li, 2012; Akhavan et al., 2012). Knowledge management has been introduced as a new specialty that should have helped us better handle the information age (Spender and Scherer, 2007). Have we lost our way since the inception of the field? Are we equipped to approach the new turn of the knowledge age or digital age artificial intelligence promises? Do we have an academic 'language' to address the managerial challenges coming ahead?

VUCA is used to describe a socio-economic reality that started after the Second World War; this term is replace now by BANI to describe 'turbulent times. The knowledge management language adopted so far fails to free itself from a metatheory that see knowledge in terms of input-output process. Already complicated business contexts are to get even more complicated. Artificial intelligence, as a tool, is the new tidal wave that will give the knowledge/digital paradigm that started at the end of the last century, its full dimension. Organizations and society alike are to be impacted the way the Industrial Revolution transformed the traditional agricultural economy. In line with BANI, the relatively stable environment on which organizations relied is changing at an increasing speed, making long-term planning a myth. Companies are to be under constant pressure as they must make important decisions while seeking organizational answers they cannot get. For example, firms face shaky banking

system that undermine the trust in the global financial system, aging workforce and attached future knowledge losses, global labour shortages that worsened since Covid-19, and new working patterns (i.e., Stocker et al., 2021).

Moving forward, some call for socio-cognitive style metatheories that can reconcile the complex role of cultural and private mental models, and how "how these are applied categorically and/or reflectively by the person in response to socio-cultural feedback mechanisms, and subsequently, how this leads to (and explains) very different meaning (knowledge transfer) outcomes" (Reihlen and Ringberg, 2013; Ringberg and Reihlen, 2008: , p. 919). While such an approach looks inclusive and holistic, it remains at the surface and consider disjunctive items and attempts to decompose these in a linear manner. An alternative worth considering is one that focused to the level of mechanisms and dynamics triggering knowledge emergence or creation (Blackler, 1995). The 2020s like the 1990s are complex and turbulent times; any attempts to describe and idealised knowledge creating / transfer / storage process is not going to help organization nor the progress of knowledge management.

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A Performance Measurement and Management System for Representing Economic, Social, and Environmental Impacts: A Pilot Case Study

Alessandro Rizzi*

Department of Management, University of Turin
C.so Unione Sovietica 218-bis, Turin, Italy

Giorgio Torchio

Department of Management , University of Turin
C.so Unione Sovietica 218-bis, Turin, Italy

Enrico Sorano

Department of Management, University of Turin
C.so Unione Sovietica 218-bis, Turin, Italy

Davide Genta

Department of Management , University of Turin
C.so Unione Sovietica 218-bis, Turin, Italy

Alberto Sardi

Department of Management , University of Turin
C.so Unione Sovietica 218-bis, Turin, Italy

** Corresponding author*

Abstract

Numerous scholars and scientific areas are investigating sustainability. Usually, it is drawn up by specific reporting which describes the economic, environmental, and social impacts of the organizational activities.
One of the main approaches for drawing up this report has been developed by Global Reporting Initiative (GRI). It defines a list of standards useful for the description of the impacts; however, these standards rarely address business management through performance measurement and management systems.
Through a pilot case study, the paper aims to represent the GRI standards and the stakeholders' needs through performance measurement and management systems.

The findings describe a useful approach to represent the GRI standards and the stakeholders' needs to illustrate economic, social, and environmental performance suggested by the GRI Standards and stakeholders' needs.

Keywords – Sustainability report, GRI standards, Performance measurement, Performance management, Performance measurement and management system.

Paper type – Academic Research Paper.

1 Introduction

Climate change is one of the effects that are changing people and companies by increasing general interest in the sustainability of the actions carried out. Sustainability is increasingly at the centre of debate on how to realize a sustainable world (Kalender & Vayvay, 2016). Over the last two decades, companies are writing sustainability reports (Kolk, 1999). The sustainability report is a reporting document that companies write to inform stakeholders of the impact of their activities on the business area (Blacconiere & Patten, 1994; Patten, 1992). Sustainability reporting is also important for the company from a management point of view as it should guide the governance and strategic choices of organizations.

To use the information collected on sustainability, companies should have a Performance Measurement and Management System (PMMS) to monitor the economic, social, and environmental impacts. The main model identified in the literature for performance measurement is the Balance Scorecard (BSC) (Kaplan & Norton, 1992), furthermore, it is a useful model to represent the organization's strategy (Sardi et al., 2020). According to the recent scientific literature, the BSC model has been integrated and modified based on the control needs of the companies; for example, it is integrated with new perspectives and key performance indicators related to the Global Reporting Initiative (GRI) standards (Kalender & Vayvay, 2016; Nikolaou & Tsalis, 2013). The integration of these aspects allows having a PMMS useful for controlling the organizational strategy toward more sustainable management of the company.

The research aims to represent the GRI Standards and stakeholders' needs through PMMS. The paper carries out a pilot case study in a key business sector from an economic, social, and environmental point of view, that is the disposal of

special, dangerous, and non-hazardous waste. The paper investigates the following research question "How can GRI standards be represented in a PMMS?".

The paper is organized as follows. Firstly, it highlights the research background. Secondly, it describes the research methods used to collect and analyze the data case study. Thirdly, it presents the main results of this study. The last section discusses and summarizes the contributions, implications, and limitations of this research.

2 Research background

From the 1990s, following Kaplan & Norton's Balance Scorecard, many PMMS models have emerged to offer innovative solutions (Taticchi et al., 2010). Kaplan and Norton identified the Balance Scorecard as a model "balanced" that combines financial and non-financial measures, dividing them into four perspectives: financial, customer, internal process, and learning and growth (Kaplan & Norton, 1992). Scholars highlight the key integration between performance measurement and performance management to improve the engagement between employees and performance (Sardi et al., 2020, 2021; Smith & Bititci, 2017). *The interplay between performance measurement, performance management, employee engagement and performance remains poorly understood in literature* (Smith & Bititci, 2017) (p. 2). However, according to Bititci and Smith, a good PMMS allows the creation of a link between performance measurement and performance management (Smith & Bititci, 2017).

PMMS is defined as *a holistic, balanced and dynamic system able to support the decision-making process through a set of performance measurement activities* (Sardi et al., 2019; Smith & Bititci, 2017). Performance measurement identifies what to measure and performance management how to use the measures to manage organization performance (Bititci et al., 2012). Performance measurement is defined as the process of quantifying the efficiency and effectiveness of action (Bianchi et al., 2015) including data gathering, data analysis and data interpreting about performance to achieve a specific goal(s) (Melnyk et al., 2014). Performance management is defined as the cultural and behavioural routines used to define performance measurement to manage the performance of the organization (Bititci, 2015). It is a process(es) to evaluate the difference between actual and desired outcomes, intending to identify and report the critical differences to can adopt strategy by management to improve the organization's performance

(Melnyk et al., 2014). According to Smith and Bititci (2017), performance measurement and performance management "*have not been conceptualised as two separate but interdependent dimensions of organisational control*" (Smith & Bititci, 2017) (p. 3).

Since the 1990s, numerous companies published a voluntary document where organizations explained the strategies for a sustainable environment called Corporate Environment Report (Cerin, 2002; Cormier & Gordon, 2001; Gray et al., 1995; Kolk, 1999; Roberts, 1991; Stittle et al., 1997). Subsequently, Corporate Environment Report was in doubt about its aim following the use by companies more to show good action to have an approval social than to join the aim of the document (Hedberg & Von Malmborg, 2003). Corporate Environment Report was turned into Corporate Sustainability Report (Kolk, 2004) including sustainability reports such as environmental, social, and economic activities, but also organization decision-making and potential conflicting goal (Godemann & Michelsen, 2011). The aim of Corporate Sustainability Report was to inform companies' stakeholders about their sustainability activities and to evaluate the impact of development sustainability of the companies (Godemann & Michelsen, 2011).

Scholars began to study the Corporate Environment Reports (CER) (Kolk, 1999) following two disasters involving the environment and/or people. Firstly, it has been a chemical disaster in Bhopal (India) (Blacconiere & Patten, 1994) and, secondly, has been Exxon Valdez oil spill disaster (Patten, 1992). CER has been studied and integrated by scholars and practitioners. In 1997, the British economist and entrepreneur John Elkington described the triple bottom line theoretical model which highlighted the importance of economic, social, and environmental performance reporting for all stakeholders through the report (Elkington, 1998). At the end of the 1990s, there was continuous interest by companies in sustainability reporting. This contest created the condition to founded Global Reporting Initiative on 27th September 1997 in Boston. The aim of GRI was "*to create the first accountability mechanism to ensure companies adhere to responsible environmental conduct principles, which was then broadened to include social, economic and governance issues*" (GRI, 2023). Following the mission "*GRI envisions a sustainable future enabled by transparency and open dialogue about impacts. This is a future in which reporting on impacts is common practice by all organizations around the world. As provider of world's most widely used sustainability disclosure standards, we are a catalyst for that change*" (GRI,

2023). GRI published the first guideline in 2000. Subsequently, GRI published the second, third and the fourth version of the GRI Guideline in 2002, 2006 and 2013. Guidelines highlight the importance to have a report to communicate the organization's action for "*a sustainable future enabled by transparency and open dialogue about impacts. This is a future in which reporting on impacts is a common practice by all organizations around the world*" (GRI, 2023). GRI are guideline reviewed "*to ensure they reflect global best practice for sustainability reporting, helping organizations respond to emerging information demands from stakeholders and regulators*" (GRI, 2023). The aim of the first guideline provided the first global framework for sustainability reporting. Today, GRI Guidelines are recognised such as GRI standards. GRI standards are the base of sustainability reporting and a model for any organization – large or small, private or public – to reporting their impacts on the economy, environment, and social point of view. GRI standards allow to compare and give credibility to the company increasing transparency on their contribution to sustainable development. Stakeholders are also more interesting to GRI standards such as investors, policymakers, capital markets, and civil society (GRI, 2023).

3 Methodology

The research adopted a qualitative method, i.e. a case study methodology (Yin, 2018). The case study was carried out from February to September 2022. This is a pilot case study, i.e. an initial study to assess its use for more in-depth studies in the future. It tests the feasibility on the full-scale study by allowing different phenomena to be observed from different angles and attempts to identify problems or obstacles that might arise. The results of the pilot study can be used to make adjustments or to decide not to proceed with a full-scale study (Yin, 2018).

Data gathering. The authors collected data from documents and semi-structured interviews. The authors collected the following documents:

- sustainability report
- financial statements.

These documents allow the definition of the GRI standards according to the BSC perspectives.

The authors carried out semi-structured interviews with the company's stakeholders to identify the main interests in the company's economic, social, and

environmental impacts according to the BSC perspectives (Yin, 2018). The interviews focused on the research topic. The questions were carefully worded to allow the interviewee to answer freely following the guideline suggested by Kallio et al., 2016 to realize a rigorous semi-structured interview.

The questions were:

1. What is the role of the company in the territory?
2. What are the activities and results of the company that you would like to know?
3. What are the main economic, environmental and social impacts you would like to know about the company's activities?

The authors interviewed the following stakeholders' categories:

- Personnel
- Public Administration
- Investors
- Shareholders
- Community (e.g. students, citizens).

Subsequently, the authors gathered information from both documents and interviews in an electronic file divided by each interview question.

Data analysis. The authors analyzed data through a within case study analysis. This analysis highlights the number of GRI standards subdivided for each BSC perspective. Furthermore, this analysis describes the GRI standards used for sustainability reporting according to the stakeholder's answers.

4 Findings

The findings of the research highlight the GRI standards used by the organization to write sustainability reporting. It describes 117 GRI standards used for the sustainability reporting divided into 36 for general disclosures, 13 for economic standards – GRI 200, 32 for environmental standards – GRI 300 and 36 for social standards – GRI 400.

The authors subdivided the GRI standards adopted by the organization to write the sustainability reporting in the BSC perspectives; various GRI standards are associated with at least two BSC perspectives.

The authors describe the number of GRI standards present in each BSC perspective (see Table 1). The results recognized the internal processes perspective as the main perspective. This perspective includes several GRI

standards such as GRI 306: "Effluents and waste", which is compatible with the business sector in which the company operates. Learn and innovation and financial perspective are enough equal. Lower importance for customer perspective.

Table 1: Number of GRI standard associated for each BSC perspective.

	GRI standards		
BSC perspective	Economic	Environment	Social
Financial	9	0	6
Customer	0	1	3
Internal process	3	26	17
Learn and Innovation	4	7	10

The finding also represents the GRI standards into the BSC perspectives according to the interests of the stakeholders with respect to the economic, environmental, and social impacts of the organization. It indicates that the stakeholders' interests are directed more for the internal process perspective (over 60%). Learn and innovation perspective is also enough directed by stakeholders' interests (over 20%). Finally, the interest of the customer and financial perspectives have minor stakeholders' interests. As in the first step, some GRI standards are associated with different perspectives (see Table 2).

Table 2: GRI standard cited for each BSC perspective by stakeholders.

	GRI standards		
BSC perspective	Economic	Environment	Social
Financial	13	0	12
Customer	0	5	6
Internal process	3	87	25
Learn and Innovation	7	14	18

The results obtained allowed the construction of the integrated PMMS with the GRI standards (see Figure 1).

Figure 1: PMMS developed from GRI standards

Financial perspective		**Customer perspective**		**Internal process perspective**		**Learn and innovation perspective**	
N.	***GRI standard***	***N.***	***GRI standard***	***N.***	***GRI standard***	***N.***	***GRI standard***
201.01	Direct economic value generated and distributed	307.01	Non-compliance with environmental laws and regulations	204.01	Proportion of spending on local suppliers	201.02	Financial implications and other risks and opportunities due to climate change
201.02	Financial implications and other risks and opportunities due to climate change	416.01	Assessment of the health and safety impacts of product and service categories	205.01	Operations assessed for risks related to corruption	202.01	Ratios of standard entry level wage by gender compared to local minimum wage
201.03	Defined benefit plan obligations and other retirement plans	416.02	Incidents of non-compliance concerning the health and safety impacts of products and services	205.03	Confirmed incidents of corruption and actions taken	203.01	Infrastructure investments and services supported
201.04	Financial assistance received from government	418.01	Substantiated complaints concerning breaches of customer privacy and losses of customer data	301.01	Materials used by weight or volume	205.02	Communication and training about anti-corruption policies and procedures
202.01	Ratios of standard entry level wage by gender compared to local minimum wage			301.02	Recycled input materials used	301.03	Reclaimed products and their packaging materials
203.01	Infrastructure investments and services supported			301.03	Reclaimed products and their packaging materials	302.03	Energy intensity
203.02	Significant indirect economic impacts			302.01	Energy consumption within the organization	302.05	Reductions in energy requirements of products and services
204.01	Proportion of spending on local suppliers			302.02	Energy consumption outside of the organization	303.03	Water withdrawal
206.01	Legal actions for anti-competitive behavior, anti-trust, and monopoly practices			302.04	Reduction of energy consumption	305.04	GHG emissions intensity
401.02	Benefits provided to full-time employees that are not provided to temporary or parttime employees			302.05	Reductions in energy requirements of products and services	305.05	Reduction of GHG emissions
401.03	Parental leave			303.01	Interactions with water as a shared resource	305.06	Emissions of ozone-depleting substances (ODS)

403.08	Workers covered by an occupational health and safety management system			303.02	Management of water discharge related impacts	403.01	Occupational health and safety management system
403.10	Work-related ill health			303.03	Water withdrawal	403.05	Worker training on occupational health and safety
413.01	Operations with local community engagement, impact assessments, and development programs			303.04	Water discharge	403.06	Promotion of worker health
415.01	Political contributions			303.05	Water consumption	403.07	Prevention and mitigation of occupational health and safety impacts directly linked by business relationships
				305.01	Direct (Scope 1) GHG emissions	404.01	Average hours of training per year per employee
				305.02	Energy indirect (Scope 2) GHG emissions	410.01	Security personnel trained in human rights policies or procedures
				305.03	Other indirect (Scope 3) GHG emissions	412.02	Employee training on human rights policies or procedures
				305.04	GHG emissions intensity	413.01	Operations with local community engagement, impact assessments, and development programs
				305.05	Reduction of GHG emissions	414.01	New suppliers that were screened using social criteria
				305.07	Nitrogen oxides (NOx), sulfur oxides (SOx), and other significant air emissions	414.02	Negative social impacts in the supply chain and actions taken
				306.01	Water discharge by quality and destination		
				306.02	Waste by type and disposal method		
				306.03	Significant spills		

				306.04	Transport and hazardous waste		
				306.05	Water bodies affected by water discharges and/or runoff		
				307.01	Non-compliance with environmental laws and regulations		
				308.01	New suppliers that were screened using environmental criteria		
				308.02	Negative environmental impacts in the supply chain and actions taken		
				401.01	New employee hires and employee turnover		
				403.02	Hazard identification, risk assessment, and incident investigation		
				403.03	Occupational health services		
				403.07	Prevenzione		
				403.09	Work-related injuries		
				403.10	Work-related ill health		
				404.02	Programs for upgrading employee skills and transition assistance programs		
				405.01	Diversity of governance bodies and employees		
				406.01	Incidents of discrimination and corrective actions taken		
				407.01	Operations and suppliers in which the right to freedom of association and collective		

					bargaining may be at risk		
				408.01	Operations and suppliers at significant risk for incidents of child labor		
				409.01	Operations and suppliers at significant risk for incidents of forced or compulsory labor		
				411.01	Incidents of violations involving rights of indigenous peoples		
				412.01	Operations that have been subject to human rights reviews or impact assessments		
				413.02	Operations with significant actual and potential negative impacts on local communities		
				414.02	Negative social impacts in the supply chain and actions taken		
				416.02	Incidents of non-compliance concerning the health and safety impacts of products and services		

5 Discussion and conclusions

Since the founding of GRI, the number of companies adopting the guidelines to publish sustainability reporting has been steadily increasing (GRI, 2023). Almost 80 % of big companies use GRI standards to write their sustainability reporting (KPMG International, 2022) because they adopt continuous improvement with constant revisions to "reflect global best practices for sustainability reporting, helping organizations respond to emerging information demands from

stakeholders and regulators" (GRI, 2023). Furthermore, these standards can be used for each size of an organization.

Since its first publication, sustainability reporting has been a document used by companies to describe their actions on the environment (UNEP, 1994). The main target groups are the stakeholders, either as an individual or groups or organisations, as they have an influence, or are influenced, on the organisational activities of a company to achieve a specific aim (Freeman, 1984).

In the case study described, the stakeholders' interest is that the company's strategies avoid a natural disaster for humans and the environment.

The increased interest in sustainability reporting has also involved Institutions. The European Commission presented the European Green Deal in 2019 and Directive 2264/2022 or 'Corporate Sustainability Reporting Directive' increased the number of companies that have to write sustainability reporting from 2023 (European Commission, 2022). In this context, PMMS becomes an important tool for any organization (Bititci et al., 2012; Franco-Santos et al., 2012) to represent the GRI standards and improve the transparency of the economic, social, and environmental impacts, especially in a business sector such as the case study analysed by the authors considered hazardous.

Sustainability reporting for many companies is a voluntary decision such as for the company in the case study. Having a reference tool for organisations to write sustainability reporting becomes important. The basis of reference can be the GRI standards although a guideline to be applied for the writing of the sustainability reporting is not yet present (La Torre et al., 2018). However, the GRI standards are the most globally known (KPMG International, 2022). The literature confirms this assumption even though other emerging organisations have defined different standards for reporting a sustainability report such as the International Financial Reporting Standards (de Villiers et al., 2022).

The research fills the lack of a representation of GRI standards through PMMS of an organisation operating in a business considered "hazardous" to the community, i.e. the management of the disposal of special, dangerous, and non-hazardous waste, especially in a historical context in which sustainability is increasing public attention.

The method used allowed representation of the economic, social, and environmental impacts in a PMMS of an organisation by combining GRI standards on the one hand and stakeholder interests on the other.

The results showed the division of the GRI standards in each perspective of the BSC (from financial statements data and semi-structured interviews) allowing the organisation to adopt the best strategies to can write sustainability reporting following the GRI standards.

The main limitation of this research is the study of a unique organization. The case study refers to a single organization that allows on the one hand, to provide a better contribution; on the other hand, it is not able to compare with other organizations.

The practical and theoretical contributions of the research are to describe a PMMS able to represent economic, social, and environmental impacts according to the scientific literature and practitioners' needs.

The practical and theoretical implications can compare and/or improve the PMMS of the selected organization with other companies. The social implications consist of making stakeholders aware of the organization's strategy in terms of sustainability.

Future opportunities concern the possibility to improve and compare the findings obtained with other organizations. The research area needs other case studies to integrate the methodology for drawing up the sustainability report following the GRI standards through the PMMS.

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Integrating SDGs in Supply Chain Performance Measurement: A Multiple Case Study

Roberta Ciccola*

Università Politecnica delle Marche
Dipartimento di Management
P.le Martelli n. 8, 60100 Ancona (Italy),

Maria Serena Chiucchi

Università Politecnica delle Marche
Dipartimento di Management
P.le Martelli n. 8, 60100 Ancona (Italy),

Giacomo Pigatto

Scuola Superiore Sant'Anna
Istituto di Management
Piazza Martiri della Libertà n. 24, 56127 Pisa (Italy)

Lino Cinquini

Scuola Superiore Sant'Anna
Istituto di Management
Piazza Martiri della Libertà n. 24, 56127 Pisa (Italy)

Andrea Tenucci

Scuola Superiore Sant'Anna
Istituto di Management
Piazza Martiri della Libertà n. 24, 56127 Pisa (Italy)

** Corresponding author*

Abstract

In today's competitive environment, measuring and managing the sustainability performance of supply chain is fundamental as organizations are considered responsible for their harmful impact as well as for their contribution to sustainable development beyond corporate boundaries. The purpose of this paper is to investigate if and how organizations embed SDGs and their targets in their supply chains and how the impacts on SDGs can be measured and assessed. To this aim, a multiple case study involving four

Italian companies is adopted. Our insights show the main supply chain practices implemented across the entire supply chain in order to achieve sustainability and SDGs. Furthermore, the preliminary findings show that performance measurement practices are critical enablers to instil a sustainability and SDGs oriented culture closing the knowledge gap with the various actors of the supply chain, especially those who exhibit a lower awareness of environmental and social issues. However, some barriers to the measurement of supply chain impacts on SDG targets are identified. In so doing, this paper contributes to prior studies on sustainability supply chain literature by providing empirical evidence on supply chain strategies and measurement practices to contribute to sustainability performance and realize a positive contribution towards the achievement of SDGs.

Keywords – Supply chain, sustainability, SDGs, performance measurement, case study.

Paper type – Academic Research Paper

1 Introduction

During the past few years, the issue of sustainability supply chain has gained considerable momentum in academic literature (e.g., Beske and Seuring, 2014; Dubey et al., 2017; Geissdoerfer et al., 2018; Luthra et al., 2017) and many organizations have started to integrate sustainability principles in their supply chains (Spence and Rinaldi, 2014; Rajeev et al., 2017). In today's competitive environment, supply chains play a key role in enhancing economic performance and they have an important impact on sustainable development (Ahi and Searcy, 2015). Thus, measuring, monitoring and managing the sustainability performance of supply chains is fundamental as organizations are considered responsible for their harmful impacts - as well as for their contribution to societal well-being - beyond corporate boundaries (Beske-Janssen et al., 2015; Qorri et al., 2018; Schaltegger and Burritt, 2014).

In response to growing concerns about evaluating and monitoring supply chain impacts (e.g., Burritt and Schaltegger, 2014; Maestrini et al., 2017), scholars have started to explore methods and tools for sustainability performance measurement and management along the supply chain. Some scholars have explored how existing tools or frameworks can be adapted by integrating the sustainability dimension (e.g., Bai and Sarkis, 2014; Yakovleva et al., 2012), while other scholars have proposed new approaches (e.g., Azevedo et al., 2017; Goyal et al., 2018). Specifically, the most popular tools are Life Cycle Assessment (Crenna et al., 2018; Del Borghi et al., 2014), Supply Chain Operations Reference (SCOR) model (Bai

and Sarkis, 2012; Taticchi et al., 2013), Balanced Scorecard for supply chain (Bhattacharya et al., 2014; Ferreira et al., 2016). Instead of addressing specific tools and approaches, some scholars have focused on the identification and selection of ad hoc sustainable performance metrics in supply chains (e.g., Ahi and Searcy, 2015; Calzolari et al., 2022), focusing primarily on environmental indicators (Bai et al, 2012).

More recently, studies have suggested that supply chains may have a fundamental role in improving economic, social and environmental benefits and particularly in the achievement of Sustainable Development Goals (SDGs) (e.g., Agrawal et al., 2022; Kayikci et al., 2022). In so doing, these studies have acknowledged that focal companies can address the 17 SDGs through specific supply chain strategies and practices. For example, Teixeira et al. (2022) have demonstrated the importance of education and training offered by the focal companies to the members of the supply chain to provide skills and knowledge crucial for the implementation of SDGs. Similarly, other scholars have emphasized the role of supplier evaluation and selection (Mina et al., 2021) or the importance of partnerships, information sharing and knowledge integration (Chauhan et al., 2022; Zhou et al., 2020).

Despite the growing attention on sustainability performance measurement of supply chains and on their role in achieving SDGs, a thorough understanding of performance measurement practices for the alignment with SDGs across supply chains is still lacking (Chauan et al., 2022). Therefore, the aim of this article is to investigate if and how organizations embed SDGs and their targets in their supply chains and how the impacts on SDGs can be measured and assessed. In doing so, this paper explores supply chain strategies and practices devised to achieve SDG targets and performance measures to quantify the impact of the supply chain on specific SDGs. To achieve this aim, a multiple case study involving four Italian companies which have implemented sustainability practices in their supply chains has been conducted. By combining theoretical insights and empirical findings this paper offers contributions to literature on sustainability supply chains.

The remainder of this paper is structured as follows. Section 2 reviews prior literature on supply chain, sustainability performance measurement and SDGs. Then, following the description of the research design provided in section 3, the preliminary findings of the study are presented in section 4. Finally, section 5 briefly summarises the main contributions and provides some concluding remarks.

2 Literature review

2.1 Sustainable Development Goals and supply chain practices

In the last few years, issues related to climate change, air and water pollution, resource waste, socioeconomic inequalities and population growth have increased pressure on organizations for pursuing sustainable development. The SDGs have been proposed as possible solutions for addressing these challenges and achieving a higher level of sustainability (Bebbington and Unerman, 2018; Mio et al., 2020). Specifically, the SDGs have been first proposed by the United Nations General Assembly within the UN 2030 Agenda in order to "stimulate action over the next 15 years in areas of critical importance for humanity and the planet" (UN, 2015: 3). They include 17 goals focused on economic, social and economic issues (see Zimon et al., 2020 for a classification) oriented towards improving well being, education, reducing inequalities and promoting peace and prosperity.

The achievement of SDGs requires coordination and collaboration at various levels, i.e. countries, companies and society. As far as companies are concerned, according to the UN Global Compact (2015), supply chains represent the most important levers for businesses to create a positive impact on people and the environment. With the advancement of the UN 2030 Agenda, businesses are called to play an active role and take a broader view in society, explore how they can support their suppliers and use their value chains to contribute towards the sustainable development (UNGC, 2015).

Scholars have recently recognized that the issuance of SDGs provides a new area of research in supply chain management (Cai and Choi, 2020; Kayikci et al., 2022; Mina et al., 2021). Nevertheless, it requires a new level of companies' commitment towards the implementation and the innovation of sustainable supply chain management (van Zanten and van Tulder, 2018; EY & UNGC, 2016).

In this regard, scholars have recently devoted their attention to the role of focal companies (i.e. "those companies that usually (1) rule or govern the supply chain, (2) provide the direct contact to the customer, and (3) design the product or service offered"; Seuring and Müller, 2008: 1699) in pursuing the 17 SDGs along their supply chain, calling for more understanding of specific supply chain strategies and practices (Agrawal et al., 2022). For instance, Teixeira et al. (2022) highlight the importance of training sessions held by the focal company for its

suppliers. In their case study, the Authors show that training suppliers by addressing topics such as eco-design or sustainable procurement was relevant for advancing and implementing SDGs in the supply chain. Likewise, Pohlman et al. (2020) suggest that collaboration and partnerships between the focal company and the main actors of a Brazilian food supply chain facilitated the promotion of SDGs and specifically the fulfilment of SDG 12 "responsible consumption and production". In turn, other scholars have explored the role of knowledge management and information sharing for promoting sustainability in supply chains reaching mixed results. Albeit not specifically focused on SDGs, Zhou et al. (2020) recognize knowledge sharing as a critical factor to push green innovation within the supply chain, while Yu et al. (2020) argue that information sharing does not always benefit the supply chain towards sustainable development. Moving towards a broader view, by adopting a grounded approach based on literature analysis, Zimon et al. (2020) identify a map of supply chain practices for an alignment with UN SDGs, including among others waste management, green product design, green purchasing, reverse logistics, green shipping and distribution.

All in all, the literature reviewed has highlighted the role of the focal company in addressing sustainability and SDGs through supply chain strategies and practices. However, resonating with recent calls, more studies on the supply chain sustainable practices for attaining SDGs are needed (Agrawal et al., 2022; Pohlman et al., 2020). Specifically, researchers have focused attention primarily on specific actors of the supply chain, i.e. suppliers (Mina et al., 2021; Teixeira et al., 2020), overseeing other fundamental stages such as manufacturing, transportation and distribution (Agrawal et al., 2022). Furthermore, "the main difficulties for the implementation of SDGs in supply chains" (Teixeira et al. 2022: 13) merit further investigations. Finally, scholars investigated among others knowledge sharing, training and green procurement practices while there is a lack of understanding about measurement and monitoring practices as we will see in the next paragraph.

2.2 Sustainability performance measurement of supply chains for an alignment with SDGs

In relation to SDGs and supply chain debate, a critical factor is represented by the performance measurement systems (Alexander and Delabre, 2019; OIBR,

2023; Zimon et al., 2020). Supply chains are considered fundamental forces driving organizational sustainability goals and commitment (EY & UNGC, 2016) and nowadays measuring and assessing supply chain sustainability performance appears urgent to determine the environmental and social effects for which organizations are held responsible (Beske and Seuring, 2014; Seuring and Gold, 2013). In response to these challenges and the growing concerns about the negative impacts occurring beyond the companies' boundaries, scholars have started to devote attention to the strategies, purposes, approaches and frameworks of supply chain sustainability performance measurement.

Academic literature has acknowledged that measuring the sustainability performance of supply chains has several purposes. First, measurement allows the improvement of the overall supply chain sustainability performance by addressing the different dimensions of sustainability (Beske-Janssen et al., 2015; Schaltegger and Burrit, 2014). Second, supply chain sustainability performance measurement consents to manage sustainability supply chain risks that may undermine company's reputation related for example to particular working conditions or excessive levels of pollution (Schaltegger and Burrit, 2014). Another key goal of sustainability performance measurement of supply chain is providing transparency about environmental and social impacts (Beske and Seuring, 2014).

Measuring and managing the sustainability performance of supply chains can be guided by three main strategies (Schaltegger and Burrit, 2014): the efficiency approach (i.e. focused on reducing waste and resource consumption along the supply chain), the consistency approach (i.e. based on the substitution of unsustainable materials with more sustainable ones) and the sufficiency approach (i.e. focused on eliminating or reducing products or parts of a product which are not strictly necessary).

However, measuring and managing sustainability along the supply chain may present various complexities because it requires suitable tools for capturing information at each stage across the entire supply chain (Qorri et al., 2018). In order to address these challenges, several scholars have first relied on existing performance measurement frameworks adding the sustainability dimension. The most popular examples are represented by the Balanced Scorecard for assessing the sustainability performance of supply chains (e.g., Bhattarcharya et al., 2014; Thanki and Thakkar, 2018), the Life Cycle Assessment with its modification (Arcese et al., 2017; Kulak et al., 2016) and the SCOR framework (Bai et al., 2012). Some scholars have proposed new approaches aimed at assessing the sustainability

performance of supply chains, combining different methodologies (e.g., mathematical modelling, sensitivity analysis) (Lee and Wu, 2014) and within specific industries (Goyal et al., 2018).

Instead of investigating specific performance measurement systems, other scholars have devoted attention to metrics' identification. As conventional indicators are primarily focused on economic issues (Beske-Janssen et al., 2015), several authors have proposed indicators that span various topics. However, these indicators are predominantly focused on environmental issues and circular economy (Calzolari et al., 2022) and they are mostly focused on measuring harmful environmental impacts (Bai et al., 2012b). The most frequently used metrics are carbon emissions or the energy consumption. Conversely, social issues are often disregarded and limited to fair trade, health and safety (Ahi and Searcy, 2015; Beske-Janssen et al., 2015).

In sum, different approaches and metrics for sustainability performance measurement have been proposed, however previous studies have focused on specific dimensions of sustainability and on particular stages of supply chain i.e. suppliers and manufacturers (Qorri et al., 2018) and few insights have been provided on comprehensive approaches to measure all three dimensions of sustainability across the entire supply chain.

Importantly, while these studies generally recognize the importance of measuring sustainability performance of supply chains, they do not provide clear insights on how performance measurement of supply chains may support sustainability improvement strategies (Beske-Janssen et al., 2015). Specifically, scholars question how to develop and implement performance measures able to assess the impact and the achievement of SDG targets in the long-term period and in the particular context of supply chains (Agrawal et al., 2022; Muñoz-Torres et al. 2018; Zimon et al. 2020). Investigating this issue seems important considering that 169 targets and 232 indicators in total underpin the 17 SDGs, providing performance measures against which the recipients of the targets are expected to be monitored. Furthermore, literature and policy makers have recognized the potential of the SDGs framework to become leading not only for governments and society but also for business (Alexander and Delabre, 2019), thus it is important to investigate whether SDGs might be integrated and guide organizations' sustainability performance measurement and management practices.

3 Research design

This paper builds on a multiple case study approach (Yin, 2014) to investigate if and how organizations embed SDGs and their targets in their supply chains and how the impacts on SDGs can be measured and assessed. The multiple case study method has been chosen for several reasons. First, the case study method has been widely recognized to be particularly suitable for an in-depth investigation of contemporary phenomena not yet explored (Eisenhardt, 1989). Second, this method is considered particularly appropriate for answering "how" questions; by providing holistic and systemic thinking, case study research is encouraged when there is the need to understand the factors influencing a phenomenon and the relations between the phenomenon itself and its context (Yin, 2014). Additionally, it has been argued that case studies allow for gathering rich information and are suitable for exploring the difficulties of implementing new accounting procedures and techniques and for evaluating the benefits or derived challenges (Scapens, 1990). For these reasons, the use of multiple case study seems to be relevant for capturing the complexities and nuances of sustainability supply chain measurement practices (Agrawal et al., 2022).

The case companies were selected through purposeful sampling (Patton, 1990); the companies involved in the study have implemented sustainability practices in their supply chains and they are engaged in measuring sustainability performance. Also, these organizations have been selected because they have implemented over the years several initiatives to align themselves with the SDGs and they are committed to measure their SDGs performance. Finally, the selection of the case studies was guided also by considerations about accessibility to relevant and internal information. The four resulting companies investigated in this study included medium and large Italian organizations from different industries (i.e., manufacturing, wholesale and retail distribution, public transportation).

The primary data sources were semi-structured interviews. 12 interviews were conducted with management accountants and sustainability managers, each interview lasted from 45 to 90 minutes and each one was recorded and immediately transcribed. The main topics covered during the interviews can be grouped into three categories. The first group of questions refers to general information about the structure and the characteristics of the supply chains of the analysed organizations. The second group inquires about the practices to align

the supply chain to sustainability and SDGs. The third group of questions examines the performance measurement systems employed by the organizations to measure sustainability performance and to pursue SDG targets. Finally, the last group of questions concerns the benefits and drawbacks of measuring sustainability performance with regard to supply chains. To allow data triangulation, semi-structured interviews were supplemented with documental analysis both of official documents (e.g., website, non financial reports) and internal documents provided by the organizations. For confidentiality reasons, the data collected about the companies have been anonymized and when presenting detailed information, we will refer to the organizations investigated as A, B, C and D.

All the data collected were analysed through a within-case analysis and cross-case analysis, which allow to look for common patterns shared between the case studies to elaborate the main findings. In our preliminary analysis, the data retrieved from the data collection were progressively coded according to the insights provided by the literature reviewed in section 2. This allowed to identify the main supply chain practices and strategies employed by the companies to extend SDG targets to their supply chains. Importantly, this allowed to identify specific management accounting practices of supply chain sustainability performance measurement.

It is important to underline that data collection and analysis of the selected cases are still ongoing and we are also adding other cases to reach saturation of evidence. Thus, in this paper we present the first insights of the analysis so far conducted.

4 Preliminary findings

The four Italian companies involved in the study play a strategic role in governing and influencing their supply chains. Although they present different levels of adoption and standardization of sustainability supply chain practices, they are all committed to integrate sustainability and SDGs within their downstream and upstream operations. The observed companies have launched several initiatives aimed at pursuing two main goals. On the one hand, initiatives are aimed at integrating the environmental and social aspects in their supply chain. On the other hand, they are aimed at obtaining information and monitoring the impact of their supply chains on sustainability issues.

The practices employed involve all the stages of the supply chain, with a specific focus on suppliers. Regarding upstream practices and particularly the procurement stage, the most implemented practice regards sustainability supplier qualification and selection (Tab. 1). The companies adopt approaches based on questionnaires which are aimed at gathering information related to the candidate suppliers, with informative purposes, or ranking eligible suppliers in tender procedures according to specific sustainability criteria. In this latter case, the criteria primarily employed concern environmental issues such as the use of materials and components which can be recyclable or reused directly at the end of their life with little or no further processing or on the possession of specific certifications and ratings like ISO 14001 or EcoVadis.

Table 1 – Examples of sustainable supply chain practices within the observed companies

SUPPLY CHAIN PRACTICES	
UPSTREAM	**DOWNSTREAM**
• Sustainability supplier qualification and selection • Carbon footprint of purchased products and services • Compliance with environmental standards and certifications • Training on sustainability and SDGs • Partnerships with suppliers for sustainability initiatives	• Green packaging • Green transportation • Raising awareness of sustainability issues • Compliance with environmental standards and certifications

In company A the suppliers' compliance with environmental standards, certifications and ratings is not mandatory to participate in tender procedures but it is associated with a score that allows to reward the most virtuous supplier in terms of sustainability. The attribution of a score linked to ESG ratings allows to motivate suppliers towards sustainable practices, without excluding from tender procedures those who are not compliant. As highlighted by company A:

> *"The possession of ESG ratings or certifications is not mandatory but is just a 'nice to have' at the moment. In this way, we avoid penalising small and medium suppliers and, by giving them a score, we motivate at the same time the implementation of sustainable practices towards reaching SDGs. Maybe in the future the possession of ESG ratings will be mandatory, but we want to support our suppliers throughout this process".*

Other practices employed in the procurement stage are: calculating the carbon footprint of products and services, measuring the suppliers' carbon emissions, implementing eco-design initiatives with suppliers' and developing joint projects to promote emerging technologies that enable to increase the use of renewable energy. Furthermore, company B has started to train its employees - and specifically its buyers - about sustainability and SDGs in order to involve suppliers in partnerships or support those with fewer competences on environmental and social issues. As highlighted by company B:

> *"We have started to train our buyers on sustainability and SDGs in order to develop fruitful relationships with suppliers. Some suppliers are very virtuous, so when we discuss about environmental or social issues we must speak the same language, so we know each other what we are doing. Other suppliers show a low awareness of SDGs and they need to be helped and supported, clearly it's our job"*.

Similarly, company D encourages its suppliers to pursue SDG 13 "climate action" by establishing appropriate corporate governance to make initiatives aimed at combating climate change and reducing emissions. Specifically, the company supports its suppliers along the transition path, providing its experience, know-how and valid approaches to sustainability issues.

Downstream supply chain practices include green packaging, i.e. packaging with recycled, reused or easily disposable materials, green transportation, i.e. using low-emission vehicles and implementing the rationalisation of transport or full-load transport. These practices are more likely to be adopted when they are connected to cost reduction and to economic sustainability, as emphasized by company C:

> *"Some initiatives have a dual impact on both the economic and social dimensions. They have allowed us to obtain cost reduction and this drives us to implement further initiatives"*.

Another common practice concerns initiatives aimed at increasing awareness among customers, for instance through public communication campaigns, about company's sustainability initiatives. Moreover, company C - operating in a business-to-business sector - invites its customers to get environmental and social ratings.

The supply chain practices so far described are predominantly aimed at contributing to and attaining at the following SDGs identified by the investigated organizations: "clean water and sanitation" (SDG 6), "affordable and clean energy"

(SDG 7) "decent work and economic growth" (SDG 8), "industry, innovation and infrastructure" (SDG 9), "sustainable cities and communities" (SDG 11), "responsible consumption and production" (SDG 12), and "climate action" (SDG 13).

In-depth interviews allowed us to understand also the current managerial accounting practices within organizations in relation to the advancement and implementation of sustainability and SDGs at a supply chain level. At this stage, a particular focus was given to the supply chain performance measurement and management systems currently in use within the organizations. All the interviewees recognized the significance of supply chain sustainability performance measurement and all the organizations use internal information systems to track the sustainability performance of upstream and downstream supply chains. Regarding environmental sustainability, the monitoring process and the relative audits are related to the measurement of emissions of the procurement and logistics processes; to this aim, as aforementioned, carbon footprint assessment of purchased goods and services is conducted and scope 3 emissions are monitored. Concerning social sustainability, indicators like the number of local suppliers, the revenues from local suppliers as well as indicators about safety procedures and gender diversity are periodically collected. In the observed cases, measurement practices are considered critical enablers to sustainability supply chain management. Particularly, they are deemed relevant to instil a sustainability and SDGs oriented culture in the main actors of the supply chains pushing them to embrace sustainability practices when their performance on the sustainability issues measured is low. This helps reduce the knowledge gap particularly with small suppliers.

However, while companies recognize that measurement practices allow to integrate SDGs principles along the supply chain, they find several barriers to assess the impacts of supply chains on SDG targets. First, the lack of common measures and difficulties related to information sharing between the focal company and external actors might hinder the monitoring process. Second, the companies find difficulties in using the SDGs framework for planning and controlling as SDGs are considered too generic and primarily referred to countries and governments. The SDGs framework is deemed relevant for communication purposes and for creating a "common ground" with the various actors of the supply chain but is considered less useful for monitoring purposes, as highlighted by company A:

"The main benefit of the SDGs framework is that it facilitates communication with those who may not know the GRI standards by hearth but instead they know the colour of SDG 12. It is very simple and clear, it represents a common ground. However, it is more complicated to translate that colour into a specific goal for the organisation, because it can be very different from organization to organization and it is difficult to adapt the specific targets to a business, as they are often too focused on a national and governmental level".

5 Conclusions

Prior studies on supply chains and sustainability have highlighted the need for companies to commit under a supply-chain perspective for promoting sustainability and the achievement of SDGs (Alexander and Delabre, 2019; OIBR, 2023; Pohlmann et al., 2022). More specifically, this paper has explored if and how organizations embed SDGs and their targets in their supply chains and how the impacts on SDGs can be measured and assessed. To reach this aim a multiple case study research has been conducted.

The preliminary findings show that the analysed companies recognize their role in realizing the challenges linked to the United Nations Sustainable Development Goals by undertaking specific initiatives in their supply chains. Moreover, the observed companies have well-structured processes and procedures for assessing the sustainable performance within their supply chains and especially with reference to their suppliers. This focus on the upstream supply chain confirms what Qorri et al. (2018) have already highlighted. Worthy of note is the fact that all companies, during the interviews, expressed their awareness about the role they play in promoting initiatives to help suppliers embrace a sustainability strategy. Similarly, the companies expressed the importance of playing the same role also towards customers to make them understand the importance of buying sustainable products. In this regard, specific actions are being undertaken (e.g. public communication campaigns or inviting customers to get social and environmental ratings and certifications).

If we consider our research questions "if and how companies embed SDGs and their targets in their supply chains and how impacts on SDGs can be measured and assessed" we can say that companies embed SDGs in their supply chain thus contributing to their achievement. Nevertheless, companies do not use the 17

SDGs and their targets and indicators for envisaging, implementing and measuring their sustainable strategies. SDGs and their targets are used ex post, to communicate or disclose the companies' sustainability strategy. *Ex ante*, when planning, and *in itinere*, when controlling the implementation of their sustainable strategy, the SDGs framework is absent. Interestingly, when talking about sustainability strategies and their measurement the analysed companies referred to the ESG framework.

This paper contributes to studies on sustainability supply chains by shedding light on sustainability performance measurement and management of supply chains. In so doing, this paper responds to wide calls to strengthen both theoretical and empirical evidence on this topic (Beske-Janssen et al., 2015; Qorri et al., 2018) and contributes to the emerging call for guidance on how to measure and improve companies' sustainability performance across supply chain to realize a positive contribution towards the achievement of SDGs (Agrawal et al., 2022; EY & UNGC, 2016). Furthermore, this paper contributes to previous studies that have investigated the purposes of supply chain measurement systems (e.g., Beske and Seuring, 2014; Schaltegger and Burrit) by showing their role in closing knowledge gaps about sustainability with actors that exhibit a low awareness of sustainability.

Second, this study provide contribution to extant research that has started to explore the role of supply chains in the achievement of SDGs (Kayikci et al., 2022; Zhou et al., 2020), by showing the relevant role and some of the practices and strategies that focal companies may embrace to extend SDG targets across each stage of supply chains. Previous studies have focused on practices implemented primarily in the procurement stage (e.g., Teixeira et al., 2022); this paper adds to this literature by providing empirical evidence about downstream practices involving distribution, transportation and customers. Furthermore, this study contributes to this literature by showing the barriers that hinder the measurement of supply chain impacts on SDGs such as the lack of common measures and common methods of calculating indicators between the focal company and the various actors of the supply chain.

This research has practical implications as it suggests strategies and practices that may facilitate the attainment of SDGs and guide managers towards the improvement of the sustainability performance of the supply chain.

It is important to underline that the research is still ongoing and that some insights emerged from the preliminary findings have to be further investigated. To this aim, we are conducting further interviews in the case organizations and we

are also adding other cases to reach saturation of evidence. This paper provides only a glimpse of the role of performance measurement as a "social and moral practice" that supports the transition path of the different actors of the supply chain towards sustainability. This topic could be explicitly addressed in the continuation of the study.

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Digital Skills and Free Market Orientation for a Sustainable Development

Gustavo Morales-Alonso*

Universidad Politécnica de Madrid
c/ José Gutiérrez Abascal, 2.
28006 Madrid, Spain

Daniel J. Gallego

Universidad Rey Juan Carlos
Pº Artilleros, s/n.
28032 Madrid, Spain

Yilsy M. Núñez

Universidad Politécnica de Madrid
c/ José Gutiérrez Abascal, 2.
28006 Madrid, Spain

Antonio Hidalgo

Universidad Politécnica de Madrid
c/ José Gutiérrez Abascal, 2.
28006 Madrid, Spain

** Corresponding author*

Abstract

Economic well-being within a society will ultimately depend on the productivity increases that occur at industry level. Digitalization and the use of ICT are tools of capital importance in this process. However, in order to scale up to industry level, they should first appear at an individual level. Having or not having ICT skills will therefore be crucial both for the individual (not to be left behind due to his/her digital divide) and the society (to keep up with the economic development of other regions). In this research we study the existing relationship between ICT skills and the free market orientation, both in its political and economic component. We find that ICT skills is a complex measure, that can interact with free market in some aspects and be independent in others. The use of on-line banking, communication technologies and the access to databases are not linked to free market orientation. But the ability to buy on-line is found to be positively correlated with free market orientation, which could speak of the existence of trust in the markets as a

facilitator of on-line purchasing. Contrarily, on-line selling is negatively correlated with free market orientation.

Keywords – Digital skills, Sustainable development, ICT, libertarianism, statism.

Paper type – Academic Research Paper

1 Introduction

Innovation and knowledge go hand in hand with sustainable economic growth and development. The former will produce the productivity increases that are the ultimate reason of a healthy and sustainable economic growth. However, the extent to which a sustainable economic growth can be leveraged with innovation and knowledge depends to a great extent of the forces affecting from the environment.

And 2023 finds the world on the so-called "VUCA environments", where VUCA stands for Volatile, Uncertain, Complex, and Ambiguous environment. This concept, originally coined to describe the world after the fall of the Berlin Wall (1989), was taken up again with more emphasis after the attacks of September 11 (2001), and is now experiencing a third youth as the world is getting closer to what the "new normal" should be. We should now face that turbulent times are here to stay.

An example of how the VUCA environment affects the economic, business and public policy spheres is the appearance in 2021 of the Great Resignation, a term that gives its name to the process of voluntary resignation of millions of workers in all parts of the world. More than 24 million American employees left their jobs in 2021 (Sull et al., 2022).

In spite of the effects coming from the environment, the acquisition of ICT skills is a process that occurs at an individual level. Therefore, it is of the greatest importance to understand what are the drivers behind the possession of ICT skills. In this research we posit free market orientation can be linked to some extent to ICT skills at individual level. We look into this issue through a survey instrument.

2 Literature review

2.1 ICT skills

A crucial component of education today is the access and use of information and communication technologies (ICT) (Castells, 2002). The lack of access to ICT can be conceptualized as the "digital divide". This concept has changed over time, from focusing on connectivity (first level of digital divide) to worrying about the development of skills and abilities required to use ICT (second level of digital divide), and to measuring the tangible results of the use of the Internet (third level of digital divide) (Scheerder et al., 2017). Its study remains of the biggest importance, as highlighted by OECD (2016), that points out that the labor market demands new skills and digital capabilities as a result of the growing use of ICT in the workplace, either in the production of ICT goods and services or the need for workers with generic or complementary ICT skills (such as the management of social media or ecommerce platforms).

The digital divide can impact at two different levels. First, at a society level: it limits the economic development due to its negative impact in productivity. And second, it can create inequalities at individual level: workers with lower ICT skills will be unable to access to well paid jobs.

In this research we look at this effect at an individual level. Previous results point towards several factors affecting use and capabilities on the Internet, such as age, educational level, and employment status (Blank and Groselj, 2014; van Deursen and van Dijk, 2014).

According to the results from Hidalgo et al. (2020), the main predictor of digital skills is the education level. From their results obtained from the main socioeconomic digital skills drivers of the Spanish population, it is concluded that there is an education level threshold that splits the society in the two first groups, in terms of their ICT capabilities: below and above secondary education. In fact, 77.8 percent of the cases with education level corresponding to the first secondary stage (primary or illiterate cases) have no or a low level of digital skills, compared to 22.2 percent of the population with this education level who have basic or above basic digital skills.

This result contrasts with the digital skills level of the population with higher education levels (university, vocational training and secondary education), for which 73.3 percent have basic or above digital skills level, compared to 26.7

percent with low or no digital skills levels. In this study, the second variable in importance is age: 90.6 percent of the sample with lower studies and an age above 44 have low or no digital skills.

2.2 Free market orientation

In opinion of the authors, the discussion between left- and right-winded policies is outdated. Contrarily, the discussion which is relevant today at economic, social and political level is whether an individual is a supporter of the free markets or a supporters of state intervention, which we will name "statism" in the following.

Free market orientation can be linked with the concepts of libertarianism or liberalism. These are philosophical perspectives that can be narrowed down to political or economic decisions. A common definition of liberalism is the one by Alberto Venegas Lynch, "the unrestricted respect for the life project of others". Also in the words of David Boaz (2010), it is "the only fundamental human right is the right to live your life as you choose, as long as you do not infringe on the equal rights of others."

As found by Boudreaux et al. (2019), those people who reside in environments that enjoy higher levels of economic freedom have a greater probability of creating a company. In this way, economic freedom is linked to business action and precedes economic growth (McMullen, Bagby, & Palich, 2008).

On the contrary, the perception of economic-administrative barriers that hinder the creation of new companies, such as financial and credit difficulties, administrative obstacles and lack of institutional support, play the opposite role: it discourages entrepreneurship (Lüthje & Franke, 2003).

That is to say, the orientation towards free market or towards statism has proven to be relevant in different domains. We believe it can also play a role in the development of ICT skills.

2.3 Research question

The thesis of this paper is that those individuals who are more critic with state intervention and have a higher orientation towards free markets will develop higher ICT skills. Therefore, the research question that drives this research is "To what extent university students perceive themselves as well skilled in ICT?". As a

sub-question, we wonder how the orientation of the individual towards the free market, both in its political and economic components affect their ICT skills perception.

3 Methodology

The abovementioned research question speaks of a study of an explanatory nature, which calls for a quantitative methodology. For this reason, the study has been conceptualized as a survey.

The instrument for data gathering is a self-administered questionnaire set into the Google Forms platform. The questionnaire is composed of 4 different sections, of which three are used for obtaining the variables analysed in the present study, and the other provides with demographic statistics of the sample. This first section accounts for demographic variables, such as age, gender, and nationality. The three sections that define the variables of this study follow, and are (i) the ICT skills section, (ii) the political orientation section, and (iii) the economic orientation section.

The ICT skills section is composed of 5 items that have been extracted from the "Survey on Equipment and Use of Information and Communication Technologies in Households", from the Spanish National Institute of Statistics (INE), which is developed following the recommendations of the Statistical Office of the European Union (EUROSTAT). These items have been expressed into a 7 points Likert scale, to make them homogeneous with the rest of the questionnaire. The ICT skills items are summarized in Table 1.

Table 1. Items used for the ICT skills variables.

Variable	Item
S1	How often have you sold goods or services online in the last 3 months (transaction or deal made online, for example, Vinted, Amazon, Wallapop...)?
S2	How often have you purchased goods or services over the Internet in the last 3 months (online transaction or deal, e.g. Vinted, Amazon, Wallapop...)?
S3	How often have you carried out Internet banking activities (including via mobile) in the last 3 months?
S4	How often have you communicated with professors or students through online audio or video tools such as Zoom, Microsoft Teams or Google Meet?
S5	How often have you accessed databases or public records (subsidies, health, work life, fines, availability of books in public libraries, cadastral registers, company registers, electoral census) through a public administration website in the last 12 months?

NB: In the scale, 1 calls for "almost never" and 7 for "very often".

For the free market orientation of the individual, we relied on the very popular dual-axis Nolan plot (Anania, et al., 2019). That is, Nolan's graph depicts the free market orientation in two axes: political orientation and economic orientation. In order to do that, ten items are set to represent personal liberty from a political stand-point and another ten from an economic point of view. In its original setting, this plot allows to differentiate respondents into four categories: libertarian, liberal, conservative, and authoritarian. The original formulation of the items has been changed to be expressed into a 7 points Likert scale. The items used can be seen in Tables 2 and 3.

Table 2. Items used for the political freedom variables.

Variable	**Item**
Opening sentence for all the items	**It is the individual, and not the State, who should decide whether you…**
PF1	…wear a seatbelt
PF2	…own a gun
PF3	…serve in the military
PF4	…smoke marijuana
PF5	…use a risky medical treatment
PF6	…engage in a homosexual relationship
PF7	…buy a pornographic video
PF8	…buy a sexist book
PF9	…send your child to a particular school
PF10	…have uncensored access to the Internet

NB: In the scale, 1 calls for "the State" and 7 for "the individual".

Table 3. Items used for the economic freedom variables.

Variable	**Item**
Opening sentence for all the items	**It is the individual, and not the State, who should decide whether you…**
EF1	…buy a foreign car
EF2	…put your retirement savings in Social Security
EF3	…give money to help the poor
EF4	…drive a taxicab without a license
EF5	…hire a worker of another race
EF6	…build a home without a permit
EF7	…pay subsidies to farmers
EF8	…work for less than minimum wage
EF9	…set up a mail-delivery company to compete with Postal Service
EF10	…purchase flood or earthquake insurance

NB: In the scale, 1 calls for "the State" and 7 for "the individual".

The data has been analysed with the correlations technique and with the principal components methodology. First, correlation matrices are obtained for each group of variables, namely (i) ICT skills, (ii) political freedom, and (iii) economic freedom. Following, variables of each group are further studied through the principal component analysis. Lastly, a correlation analysis for the complete gathering of 25 variables is performed. The results obtained are presented in the next section.

4 Results

4.1 Descriptive statistics

The questionnaire was administered in two public Spanish universities, namely Universidad Politécnica de Madrid and Universidad Rey Juan Carlos, in February 2023. Researchers visited the room at the beginning or the end of the lesson, and asked the students to respond the survey anonymous- and voluntarily. The questionnaire was made accessible through a QR code and a link so that each student could respond it on his/her own phone.

A total of 257 responses were gathered, of which 155 were men (60%) and 102 women (40%). The average age is 20.3 years old, with a standard deviation of 2.93 years.

The first set of variables are the digital skills (S1 – S5). Their descriptive statistics are summarized in Table 4. Noteworthy, highest means are for S3 (4.88, "Internet banking activities") and S2 (3.94 "purchased goods or services over the Internet"), and the lowest is S1 (1.98, "you sold goods or services online").

Table 4. Descriptive statistics for the ICT skills variables.

Variable	Mean	Std. Deviation	N
S1	1.98	1.521	256
S2	3.94	1.765	256
S3	4.88	2.098	256
S4	3.46	1.851	256
S5	2.88	1.719	256

NB: In the scale, 1 calls for "almost never" and 7 for "very often".

The second group of variables of this study are the metrics of political freedom (PF1 – PF10), see Table 5 for their descriptive statistics. Highest values are obtained for PF9 (5.02, "It is the individual, and not the State, who should decide whether you send your child to a particular school") and PF10 (5.89, "It is the individual, and not the State, who should decide whether you have uncensored access to the Internet"), while the lowest appears for PF2 (2.05, "It is the individual, and not the State, who should decide whether you own a gun").

Table 5. Descriptive statistics for the political freedom variables.

Variable	Mean	Std. Deviation	N
PF1	4.61	2.493	248
PF2	2.05	1.852	248
PF3	3.83	2.591	248
PF4	3.43	2.364	248
PF5	3.78	2.544	248
PF6	4.37	2.851	248
PF7	4.46	2.370	248
PF8	3.72	2.534	248
PF9	5.02	2.466	248
PF10	5.89	1.722	248

NB: In the scale, 1 calls for "the State" and 7 for "the individual".

The third and last set of variables is the one used to capture the economic leaning towards free markets (EF1 – EF10), for which Table 6 summarizes the results obtained. The highest values are obtained for EF5 (5.47, "It is the individual, and not the State, who should decide whether you hire a worker of another race"), EF1 (5.12, "It is the individual, and not the State, who should decide whether you buy a foreign car"), EF3 (5.10, "It is the individual, and not the State, who should decide whether you give money to help the poor"), while the lowest is for EF4 (1.96, "It is the individual, and not the State, who should decide whether you drive a taxicab without a license").

Table 6. Descriptive statistics for the economic freedom variables.

Variable	Mean	Std. Deviation	N
EF1	5.12	2.374	239
EF2	4.56	2.298	239
EF3	5.10	2.164	239
EF4	1.96	1.696	239
EF5	5.47	2.180	239
EF6	2.53	1.909	239
EF7	3.30	2.100	239
EF8	2.69	2.172	239
EF9	3.86	2.315	239
EF10	4.89	2.332	239

NB: In the scale, 1 calls for "the State" and 7 for "the individual".

4.2 Findings

From the descriptive statistics of the variables presented above, the respondents can be described as averaged-skills in terms of ICT, being the average of the 5 independent means of the variables equal to 3.43, just below half of the scale. They are more skilled in banking activities and buying through the Internet, but less prone to sell on-line.

A correlation matrix was obtained for the ICT skills, but all the correlation coefficients are below 0.35 between S1 – S5 variables. For this reason, the correlation matrix is not presented here. This result speaks of the ICT skills variables measuring concepts that are different from each other, at least when focus is solely put into ICT skills variables. As it will be shown later, the ICT skills will correlate better when analysed together with the rest of the variables of the study. When principal components are obtained for the ICT skills variables, the 5 variables group around a single component, that explains 31.88% of variance, see Table 7.

Table 7. Principal components for the ICT skills variables.

Variable	Component 1
S1	.294
S2	.428
S3	.539
S4	.693
S5	.744

Regarding the political freedom measures, the results obtained point towards a shortly above-average sample leaning towards political freedom (average of 4.11 over 7). The respondents support that the State decides who can own a gun, but not the schooling of children nor censoring Internet. The correlation matrix depicts a link between PF3, PF4, PF5, PF6, PF7, PF8 and PF9.

This link is further confirmed by the principal components obtained (see Table 8), for which a first principal component account for all these variables, explaining 49.91% of variance. A second component is composed by PF10 ("It is the individual, and not the State, who should decide whether you have uncensored access to the Internet"), with 10.78% of variance explained, and a third component driven by PF2 ("It is the individual, and not the State, who should decide whether you own a gun"), with another 10.7% of variance explained. All in all, these three components explain a 71.39% of variance. These last two components account for the highest and the lowest average values obtained in this part of the survey.

Table 8. Principal components (rotated matrix) for the political freedom variables.

Variable	Component 1	Component 2	Component 3
PF1	-.670	.158	.297
PF2	.097	-.041	.940
PF3	.820	-.190	.077
PF4	.709	.009	.234
PF5	.835	-.066	.086
PF6	.919	-.037	-.046
PF7	.770	.239	.072
PF8	.825	.136	.146
PF9	.736	.013	-.005
PF10	-.007	.966	-.033

Last but not least, the economic freedom variables present an overall average of 3.94 (over 7). Again, over the half of the scale but slightly lower than the result obtained for political freedom (4.11). The correlation matrix shows that EF1, EF2, EF3, and EF10 are correlated. On the other hand, also EF4 ("It is the individual, and not the State, who should decide whether you drive a taxicab without a license") and EF6 ("It is the individual, and not the State, who should decide whether you build a home without a permit") appear to be correlated.

In this case, two components are formed after the principal components analysis is performed. The first component accounts for the abovementioned factors EF1, EF2, EF3, and EF10, together with EF5 and EF9. This component accounts for 34.43% of the variance. A second component, explaining another 19.12% (being therefore the accumulative variance explained of 53.55%), gathers the variables EF4 and EF6.

Table 9. Principal components (rotated matrix) for the economic freedom variables.

Variable	Component 1	Component 2
EF1	.770	.173
EF2	.801	.088
EF3	.835	-.011
EF4	.018	.810
EF5	.603	.098
EF6	.027	.853
EF7	.427	.290
EF8	.225	.520
EF9	.557	.353
EF10	.777	.035

A last analysis has been performed, with the aim of understanding how the variables from one section of the survey impact on the variables of a different section. To that end, a correlation analysis that includes the 25 variables under study has been performed, as detailed in Table 10.

From these correlations, three main conclusions can be driven. First, variables S3 ("Internet banking activities"), S4 ("communicated with professors or students"), and S5 ("accessed databases or public records") correlate positively with each other and with S2, and only one correlation is found with the complete set of variables PF1 – PF10 and EF1 – EF10. This is a far-reaching result, as it proves that certain ICT skills are independent from political and economic orientations. Second, S1 ("sold goods or services online") does not correlate with any of the rest of variables from ICT skills, but correlates negatively with PF3, PF6, PF7, PF8 and EF2. And third and last, S2 ("purchased goods or services over the Internet") correlates positively with S5 and also with PF5, EF3, EF5 and EF10.

Table 10. Correlation analysis for the ICT skills, the political freedom, and the economic freedom variables.

		S1	S2	S3	S4	S5	PF1	PF2	PF3	PF4	PF5	PF6	PF7
S1	Pearson Correlation	1	,027	,069	,121	,062	,068	,021	-,145*	-,073	-,106	-,164**	-,198**
	Sig. (2-tailed)		,664	,268	,053	,322	,282	,735	,020	,250	,091	,009	,002
	N	257	257	256	257	257	255	255	255	253	255	255	254
S2	Pearson Correlation	,027	1	,085	,117	,169**	-,074	,050	,057	,098	,124*	,105	,114
	Sig. (2-tailed)	,664		,175	,062	,007	,240	,424	,366	,121	,047	,093	,069
	N	257	257	256	257	257	255	255	255	253	255	255	254
S3	Pearson Correlation	,069	,085	1	,144*	,220**	-,004	,034	,047	,048	,068	,032	,098
	Sig. (2-tailed)	,268	,175		,021	,000	,943	,593	,458	,446	,277	,616	,120
	N	256	256	256	256	256	254	254	254	252	254	254	253
S4	Pearson Correlation	,121	,117	,144*	1	,339**	-,002	,037	,096	,080	,010	,058	-,020
	Sig. (2-tailed)	,053	,062	,021		,000	,974	,556	,126	,204	,871	,355	,749
	N	257	257	256	257	257	255	255	255	253	255	255	254
S5	Pearson Correlation	,062	,169**	,220**	,339**	1	-,024	,026	,061	,088	-,034	,017	,111
	Sig. (2-tailed)	,322	,007	,000	,000		,704	,683	,336	,161	,592	,782	,076
	N	257	257	256	257	257	255	255	255	253	255	255	254
PF1	Pearson Correlation	,068	-,074	-,004	-,002	-,024	1	,015	-,513**	-,326**	-,520**	-,595**	-,389**
	Sig. (2-tailed)	,282	,240	,943	,974	,704		,809	,000	,000	,000	,000	,000
	N	255	255	254	255	255	255	255	255	253	255	255	254
PF2	Pearson Correlation	,021	,050	,034	,037	,026	,015	1	,145*	,168**	,146*	,071	,101
	Sig. (2-tailed)	,735	,424	,593	,556	,683	,809		,021	,007	,020	,260	,109
	N	255	255	254	255	255	255	255	255	253	255	255	254
PF3	Pearson Correlation	-,145*	,057	,047	,096	,061	-,513**	,145*	1	,611**	,629**	,742**	,538**
	Sig. (2-tailed)	,020	,366	,458	,126	,336	,000	,021		,000	,000	,000	,000
	N	255	255	254	255	255	255	255	255	253	255	255	254
PF4	Pearson Correlation	-,073	,098	,048	,080	,088	-,326**	,168**	,611**	1	,624**	,608**	,527**
	Sig. (2-tailed)	,250	,121	,446	,204	,161	,000	,007	,000		,000	,000	,000
	N	253	253	252	253	253	253	253	253	253	253	253	252
PF5	Pearson Correlation	-,106	,124*	,068	,010	-,034	-,520**	,146*	,629**	,624**	1	,729**	,599**
	Sig. (2-tailed)	,091	,047	,277	,871	,592	,000	,020	,000	,000		,000	,000
	N	255	255	254	255	255	255	255	255	253	255	255	254
PF6	Pearson Correlation	-,164**	,105	,032	,058	,017	-,595**	,071	,742**	,608**	,729**	1	,689**
	Sig. (2-tailed)	,009	,093	,616	,355	,782	,000	,260	,000	,000	,000		,000
	N	255	255	254	255	255	255	255	255	253	255	255	254

PF7	Pearson Correlation	-,198**	,114	,098	-,020	,111	-,389**	,101	,538**	,527**	,599**	,689**	1
	Sig. (2-tailed)	,002	,069	,120	,749	,076	,000	,109	,000	,000	,000	,000	
	N	254	254	253	254	254	254	254	254	252	254	254	254
PF8	Pearson Correlation	-,140*	,088	,064	,064	,046	-,443**	,181**	,621**	,556**	,646**	,725**	,672**
	Sig. (2-tailed)	,026	,166	,313	,311	,466	,000	,004	,000	,000	,000	,000	,000
	N	252	252	252	252	252	252	252	252	250	252	252	252

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 10. Correlation analysis for the ICT skills, the political freedom, and the economic freedom variables (continued, 1 of 3).

		PF8	PF9	PF10	EF1	EF2	EF3	EF4	EF5	EF6	EF7	EF8	EF9	EF10
S1	Pearson Correlation	-,140*	-,097	,004	-,101	-,148*	-,081	-,121	,031	-,011	-,042	-,028	-,045	-,097
	Sig. (2-tailed)	,026	,124	,948	,111	,019	,199	,056	,624	,860	,505	,655	,477	,125
	N	252	253	253	252	253	252	250	253	253	250	250	248	249
S2	Pearson Correlation	,088	,119	-,059	,115	,103	,140*	-,001	,145*	,069	,077	-,005	,032	,146*
	Sig. (2-tailed)	,166	,060	,348	,068	,101	,026	,990	,021	,273	,226	,943	,616	,021
	N	252	253	253	252	253	252	250	253	253	250	250	248	249
S3	Pearson Correlation	,064	,022	-,114	,097	,018	,051	,064	,123	,084	,120	,069	,097	,020
	Sig. (2-tailed)	,313	,732	,071	,127	,776	,422	,316	,052	,184	,058	,281	,128	,757
	N	252	252	252	251	252	251	249	252	252	249	249	247	248
S4	Pearson Correlation	,064	,073	-,127*	,041	,052	,109	-,016	,016	-,027	,108	,032	-,083	,095
	Sig. (2-tailed)	,311	,246	,044	,519	,409	,083	,795	,799	,672	,088	,618	,194	,135
	N	252	253	253	252	253	252	250	253	253	250	250	248	249
S5	Pearson Correlation	,046	,031	-,004	,110	,020	,008	-,029	-,099	,089	,078	-,109	,071	,105
	Sig. (2-tailed)	,466	,623	,955	,081	,748	,903	,652	,116	,159	,217	,085	,263	,099
	N	252	253	253	252	253	252	250	253	253	250	250	248	249
PF1	Pearson Correlation	-,443**	-,462**	,070	-,479**	-,433**	-,476**	-,060	-,217**	-,087	-,141*	-,182**	-,302**	-,332**
	Sig. (2-tailed)	,000	,000	,267	,000	,000	,000	,345	,001	,166	,026	,004	,000	,000
	N	252	253	253	252	253	252	250	253	253	250	250	248	249
PF2	Pearson Correlation	,181**	,133*	-,029	,048	,001	-,017	,316**	-,070	,257**	,088	,180**	,128*	,063
	Sig. (2-tailed)	,004	,034	,643	,445	,982	,790	,000	,269	,000	,167	,004	,043	,323
	N	252	253	253	252	253	252	250	253	253	250	250	248	249
PF3	Pearson Correlation	,621**	,566**	-,143*	,545**	,506**	,491**	,186**	,242**	,147*	,206**	,198**	,306**	,387**
	Sig. (2-tailed)	,000	,000	,023	,000	,000	,000	,003	,000	,019	,001	,002	,000	,000
	N	252	253	253	252	253	252	250	253	253	250	250	248	249

PF4	Pearson Correlation	,556**	,353**	-,012	,388**	,388**	,366**	,109	,136*	,146*	,106	,121	,197**	,321**
	Sig. (2-tailed)	,000	,000	,853	,000	,000	,000	,087	,032	,021	,095	,058	,002	,000
	N	250	251	251	250	251	250	248	251	251	248	248	246	247
PF5	Pearson Correlation	,646**	,546**	-,073	,526**	,546**	,473**	,086	,270**	,089	,251**	,258**	,338**	,456**
	Sig. (2-tailed)	,000	,000	,247	,000	,000	,000	,177	,000	,158	,000	,000	,000	,000
	N	252	253	253	252	253	252	250	253	253	250	250	248	249
PF6	Pearson Correlation	,725**	,674**	-,057	,635**	,581**	,621**	,116	,380**	,128*	,244**	,236**	,347**	,451**
	Sig. (2-tailed)	,000	,000	,366	,000	,000	,000	,066	,000	,042	,000	,000	,000	,000
	N	252	253	253	252	253	252	250	253	253	250	250	248	249
PF7	Pearson Correlation	,672**	,458**	,097	,510**	,509**	,443**	,141*	,252**	,143*	,199**	,221**	,359**	,379**
	Sig. (2-tailed)	,000	,000	,122	,000	,000	,000	,026	,000	,023	,002	,000	,000	,000
	N	252	253	253	251	252	251	249	252	252	250	249	247	248
PF8	Pearson Correlation	1	,530**	,060	,510**	,478**	,505**	,163*	,274**	,168**	,201**	,245**	,362**	,445**
	Sig. (2-tailed)		,000	,341	,000	,000	,000	,010	,000	,008	,001	,000	,000	,000
	N	252	251	251	249	250	249	247	250	250	248	247	245	246

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 10. Correlation analysis for the ICT skills, the political freedom, and the economic freedom variables (continued, 2 of 3).

		S1	S2	S3	S4	S5	PF1	PF2	PF3	PF4	PF5	PF6	PF7
PF9	Pearson Correlation	-,097	,119	,022	,073	,031	-,462**	,133*	,566**	,353**	,546**	,674**	,458**
	Sig. (2-tailed)	,124	,060	,732	,246	,623	,000	,034	,000	,000	,000	,000	,000
	N	253	253	252	253	253	253	253	253	251	253	253	253
PF10	Pearson Correlation	,004	-,059	-,114	-,127*	-,004	,070	-,029	-,143*	-,012	-,073	-,057	,097
	Sig. (2-tailed)	,948	,348	,071	,044	,955	,267	,643	,023	,853	,247	,366	,122
	N	253	253	252	253	253	253	253	253	251	253	253	253
EF1	Pearson Correlation	-,101	,115	,097	,041	,110	-,479**	,048	,545**	,388**	,526**	,635**	,510**
	Sig. (2-tailed)	,111	,068	,127	,519	,081	,000	,445	,000	,000	,000	,000	,000
	N	252	252	251	252	252	252	252	252	250	252	252	251
EF2	Pearson Correlation	-,148*	,103	,018	,052	,020	-,433**	,001	,506**	,388**	,546**	,581**	,509**
	Sig. (2-tailed)	,019	,101	,776	,409	,748	,000	,982	,000	,000	,000	,000	,000
	N	253	253	252	253	253	253	253	253	251	253	253	252
EF3	Pearson Correlation	-,081	,140*	,051	,109	,008	-,476**	-,017	,491**	,366**	,473**	,621**	,443**
	Sig. (2-tailed)	,199	,026	,422	,083	,903	,000	,790	,000	,000	,000	,000	,000
	N	252	252	251	252	252	252	252	252	250	252	252	251

EF4	Pearson Correlation	-,121	-,001	,064	-,016	-,029	-,060	,316**	,186**	,109	,086	,116	,141*
	Sig. (2-tailed)	,056	,990	,316	,795	,652	,345	,000	,003	,087	,177	,066	,026
	N	250	250	249	250	250	250	250	250	248	250	250	249
EF5	Pearson Correlation	,031	,145*	,123	,016	-,099	-,217**	-,070	,242**	,136*	,270**	,380**	,252**
	Sig. (2-tailed)	,624	,021	,052	,799	,116	,001	,269	,000	,032	,000	,000	,000
	N	253	253	252	253	253	253	253	253	251	253	253	252
EF6	Pearson Correlation	-,011	,069	,084	-,027	,089	-,087	,257**	,147*	,146*	,089	,128*	,143*
	Sig. (2-tailed)	,860	,273	,184	,672	,159	,166	,000	,019	,021	,158	,042	,023
	N	253	253	252	253	253	253	253	253	251	253	253	252
EF7	Pearson Correlation	-,042	,077	,120	,108	,078	-,141*	,088	,206**	,106	,251**	,244**	,199**
	Sig. (2-tailed)	,505	,226	,058	,088	,217	,026	,167	,001	,095	,000	,000	,002
	N	250	250	249	250	250	250	250	250	248	250	250	250
EF8	Pearson Correlation	-,028	-,005	,069	,032	-,109	-,182**	,180**	,198**	,121	,258**	,236**	,221**
	Sig. (2-tailed)	,655	,943	,281	,618	,085	,004	,004	,002	,058	,000	,000	,000
	N	250	250	249	250	250	250	250	250	248	250	250	249
EF9	Pearson Correlation	-,045	,032	,097	-,083	,071	-,302**	,128*	,306**	,197**	,338**	,347**	,359**
	Sig. (2-tailed)	,477	,616	,128	,194	,263	,000	,043	,000	,002	,000	,000	,000
	N	248	248	247	248	248	248	248	248	246	248	248	247
EF10	Pearson Correlation	-,097	,146*	,020	,095	,105	-,332**	,063	,387**	,321**	,456**	,451**	,379**
	Sig. (2-tailed)	,125	,021	,757	,135	,099	,000	,323	,000	,000	,000	,000	,000
	N	249	249	248	249	249	249	249	249	247	249	249	248

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 10. Correlation analysis for the ICT skills, the political freedom, and the economic freedom variables (continued, 3 of 3).

		PF8	PF9	PF10	EF1	EF2	EF3	EF4	EF5	EF6	EF7	EF8	EF9	EF10
PF9	Pearson Correlation	,530**	1	,034	,580**	,554**	,498**	,067	,364**	,111	,181**	,200**	,243**	,430**
	Sig. (2-tailed)	,000		,594	,000	,000	,000	,296	,000	,078	,004	,002	,000	,000
	N	251	253	252	250	251	250	248	251	251	249	248	246	247
PF10	Pearson Correlation	,060	,034	1	,076	,087	-,045	-,065	,087	,099	-,082	-,087	-,024	-,012
	Sig. (2-tailed)	,341	,594		,229	,168	,477	,310	,169	,116	,198	,174	,711	,852
	N	251	252	253	251	252	251	249	252	252	250	249	247	248
EF1	Pearson Correlation	,510**	,580**	,076	1	,652**	,546**	,140*	,411**	,252**	,268**	,195**	,397**	,514**

	Sig. (2-tailed)	,000	,000	,229		,000	,000	,028	,000	,000	,000	,002	,000	,000
	N	249	250	251	252	252	251	249	252	252	249	249	247	248
EF2	Pearson Correlation	,478**	,554**	,087	,652**	1	,623**	,118	,390**	,149*	,357**	,221**	,352**	,493**
	Sig. (2-tailed)	,000	,000	,168	,000		,000	,062	,000	,018	,000	,000	,000	,000
	N	250	251	252	252	253	252	250	253	253	250	250	248	249
EF3	Pearson Correlation	,505**	,498**	-,045	,546**	,623**	1	,089	,458**	,045	,284**	,210**	,364**	,596**
	Sig. (2-tailed)	,000	,000	,477	,000	,000		,160	,000	,474	,000	,001	,000	,000
	N	249	250	251	251	252	252	249	252	252	249	249	247	248
EF4	Pearson Correlation	,163*	,067	-,065	,140*	,118	,089	1	,060	,530**	,184**	,221**	,228**	,098
	Sig. (2-tailed)	,010	,296	,310	,028	,062	,160		,343	,000	,004	,000	,000	,124
	N	247	248	249	249	250	249	250	250	250	247	247	245	246
EF5	Pearson Correlation	,274**	,364**	,087	,411**	,390**	,458**	,060	1	,153*	,203**	,135*	,261**	,274**
	Sig. (2-tailed)	,000	,000	,169	,000	,000	,000	,343		,015	,001	,033	,000	,000
	N	250	251	252	252	253	252	250	253	253	250	250	248	249
EF6	Pearson Correlation	,168**	,111	,099	,252**	,149*	,045	,530**	,153*	1	,192**	,290**	,258**	,049
	Sig. (2-tailed)	,008	,078	,116	,000	,018	,474	,000	,015		,002	,000	,000	,439
	N	250	251	252	252	253	252	250	253	253	250	250	248	249
EF7	Pearson Correlation	,201**	,181**	-,082	,268**	,357**	,284**	,184**	,203**	,192**	1	,199**	,235**	,266**
	Sig. (2-tailed)	,001	,004	,198	,000	,000	,000	,004	,001	,002		,002	,000	,000
	N	248	249	250	249	250	249	247	250	250	250	247	246	246
EF8	Pearson Correlation	,245**	,200**	-,087	,195**	,221**	,210**	,221**	,135*	,290**	,199**	1	,276**	,210**
	Sig. (2-tailed)	,000	,002	,174	,002	,000	,001	,000	,033	,000	,002		,000	,001
	N	247	248	249	249	250	249	247	250	250	247	250	247	248
EF9	Pearson Correlation	,362**	,243**	-,024	,397**	,352**	,364**	,228**	,261**	,258**	,235**	,276**	1	,522**
	Sig. (2-tailed)	,000	,000	,711	,000	,000	,000	,000	,000	,000	,000	,000		,000
	N	245	246	247	247	248	247	245	248	248	246	247	248	247
EF10	Pearson Correlation	,445**	,430**	-,012	,514**	,493**	,596**	,098	,274**	,049	,266**	,210**	,522**	1
	Sig. (2-tailed)	,000	,000	,852	,000	,000	,000	,124	,000	,439	,000	,001	,000	
	N	246	247	248	248	249	248	246	249	249	246	248	247	249

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

5 Conclusions

Economic development and economic well-being are very dependent on economic growth. And economic growth is ultimately driven by productivity

increases, especially in developed countries in which population demographics are shrinking. In this setting, the ICT skills of the members of the society can be of the greatest importance. In this study we look into ICT skills and their link to free market orientations of the individuals. We do so by means of a questionnaire answered by 257 respondents.

The results obtained speak of a young sample (20.3 years of age), composed of university students, and skewed towards men (60% male, 40% female). In this sample, respondents find themselves as averaged-skilled in terms of ICT (3.43 in a 7 points scale). The respondents are particularly prone to the use of on-line banking and on-line purchasing, but do not lean towards on-line selling.

The individuals of the sample are in the middle of the scale between libertarianism and statism, but slightly leaning towards the former. They are, both for political and economic freedom in the upper-middle range of the scale (4.11 and 3.94, respectively). From a political or personal freedom standpoint, respondents feel that choosing the school of their offspring and accessing Internet without censorship are their more valued freedoms. Contrarily, they feel that the State should decide who can have access to guns. In terms of economic freedom, respondents support the ability of hiring workers independently of their race, but are less flexible with the existence of taxi drivers operating without a license.

When ICT skills and free market orientation are sought after together, we find that on-line banking, the use of on-line meetings and the access to personal data bases seem to be skills purely independent of free market orientation. Contrarily, selling on-line is negatively correlated with free market orientation, while buying on-line is positively correlated.

We hypothesize that individuals with a more critical view of State intervention in the economy are individuals with higher human capital, better informed and prepared, and possibly from wealthier environments. For this reason, they are more prone to develop trust in the markets, and therefore decide to buy on-line. They would be following the pro-trade ideas of Spanish thinker Antonio Escohotado: "the only alternative to trade is violence". Somehow, respondents that purchase on-line are hoping for a honest person on the other side of the market, who just wants to trade and make a profit.

Contrarily, selling on-line in our sample may come from a necessity rather than the search of a business opportunity. This could probably mean that on-line

sellers in the sample have a lower income level, and are more favourable to the intervention of the State, and less prone to free markets.

In spite of its contributions, this study is not free from limitations. The sample in use is limited to university students from Spain. More data would be needed to dig deeper in the results presented here.

Last, as an avenue for further research, we call for the gathering of data from different settings, both in age and in cultures.

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Human Component in Sustainable Digitization: Towards a Conceptual Framework

Virginia Dolci*

Department of Economics, Science and Law
University of the Republic of San Marino
via Consiglio dei Sessanta, 99 – Dogana (San Marino)

Alberto Petroni

Department of Engineering and Architecture
University of Parma
Parco Area delle Scienze 181/A

Benedetta Pini

Department of Engineering and Architecture
University of Parma
Parco Area delle Scienze 181/A

Leonardo Tagliente

Department of Economics, Science and Law
University of the Republic of San Marino
via Consiglio dei Sessanta, 99 – Dogana (San Marino)

** Corresponding author*

Abstract

Since the late 20th century, the introduction of digital technologies has revolutionized the way people interact with the world. This has led to the mass diffusion of the Internet, smartphones, global computer networks and virtual reality, which have become an integral part of people's daily lives. This digital transformation has had a significant impact on all spheres of human activity, including work. In addition, unexpected events such as the COVID-19 pandemic forced organizations to digitize rapidly to conduct business, despite social restrictions. This has contributed to the emergence of new paradigms in the world of work. In manufacturing sectors, the industry 4.0 model using automation, robotics, artificial intelligence, the Internet of Things and additive manufacturing has enabled manufacturing companies to optimize processes, reduce costs and improve service efficiency.
While digital tools have a positive impact on economic and environmental aspects, they also force organizations to reconceive the role of human activity in the workplace. This

revolution in the world of work can, however, have both positive and negative implications for an organization's human resources. It is the responsibility of organizations to choose whether to adopt a sustainable approach that balances economic, environmental, and social factors.
Specifically, to preserve social sustainability, organizations should adopt human resource management practices that place human capital at the centre of the transition to digital workplaces. This requires providing employees with digital skills for decent and rewarding employment.
This paper aims to provide an analysis on the topic of digitization and social responsibility, where humans are at the centre of interest for organizations. Conflicting views on the effects of digital transformation on social sustainability make this an important topic for research. To investigate this gap, we adopted a two-stage methodology. In the first stage, we conducted a systematic literature review to understand the most widely discussed research topics on the topic to date. Then, based on these findings, we conducted an exploratory case study. Specifically, this paper analyses a San Marino company operating in the medical sector. This case is particularly interesting in that it highlights the effects of social sustainability related to digital transformation, both from the perspective of the organization and the beneficiaries of the product/service. The case study will allow for feedback and empirical validation of what is known in the scientific literature.

Keywords – Digitalization, Sustainability, Human resources

Paper type – Academic Research Paper

1 Introduction

The World Wide Web was created in the 1980s and within 21 years it had become a central element of the global economy, used by nearly 40% of the world's population. The number of digital devices has reached 100 million users and in 12 years the Internet has gathered its first billion users (Castells, 1996). This marked the beginning of a digital revolution: the emerging world adopted mobile phones, and therefore increased use of the Internet. Mobile connectivity enabled socio-economic growth and increased commercial opportunities (Digital Evolution Index, 2015). The 1990s saw a shift towards digitization in the field of information storage and transmission, which marked a departure from previous analogue technologies. This shift towards digitization has brought people together around the world, providing a common platform and language for sharing ideas and experiences (Castells, 1996). The rapid development of digital technologies has led to a profound transformation of society and the economy,

with significant impacts on businesses, workers, and consumers (Grigorescu, Pelinescu, Ion, & Dutcas, 2021).

In the industrial sector, the integration of advanced digital technologies such as the Internet of Things, cloud computing and artificial intelligence (industry 4.0), has opened new opportunities for innovation and growth. (Almeida, Santos & Monteiro, 2020). As a result, the production of new knowledge-based products and services and more efficient production processes have been developed (Bigliardi, Filippelli, Petroni, & Tagliente, 2022). There is no doubt that this new digital age has brought about disruption to existing industries and markets, creating both opportunities and challenges for businesses and workers. This concept is summed up in the term "digital disruption", which attributes to digital technologies the merit of being bearers of innovation and growth on the one hand but a source of inconvenience and uncertainty for workers and companies on the other (Nyagadza, 2023).

The theme of digitization has assumed an even more important role in the wake of the Covid 19 Pandemic. Indeed, the COVID-19 pandemic has had a profound impact on the world of work, accelerating the adoption of digital technologies and changing the way many companies operate (Almeida, Santos & Monteiro, 2020). As a result of the pandemic, many companies have been forced to make a rapid transition to remote working and digital collaboration tools, leading to a significant increase in the use of digital technologies such as video conferencing, cloud computing and digital project management tools (Sima, Gheorghe, Subić, & Nancu, 2020).

While the rapid adoption of digital technologies has allowed many businesses to stay operational during the pandemic, it has also highlighted the digital divide between those with access to digital technologies and those who don't (Sima, Gheorghe, Subić, & Nancu, 2020). Additionally, the shift to teleworking has raised concerns about the impact of digitalisation on job security, work-life balance, and mental health. Collectively, the COVID-19 pandemic has demonstrated the importance of digitization in enabling businesses to adapt to change and continue operating despite disruptions (Nyagadza, 2023). However, the pandemic has also highlighted the need for policies and initiatives to promote digital inclusion and ensure that the benefits of digitization are shared equally across society (Nyagadza, 2023).

From the workers' point of view, there are situations in which digitization offers opportunities, as it improves, speeds up and facilitates specific activities and

processes. On the other hand, workers also face the risk of job loss, when some activities become obsolete and digitally replaceable, and the difficulty of learning new technologies and adapting to new work processes (Harteis, Goller, & Caruso, 2020). To overcome these challenges, workers need to develop new skills and competencies, such as digital literacy, data analysis and critical thinking, which can be supported through comprehensive training programs and educational initiatives (Harteis, Goller, & Caruso, 2020). Furthermore, HR departments play a crucial role in this process by providing workers with the support and resources they need to develop these skills (Kuzior, Kettler, & Rąb, 2022). While digitization can lead to job displacement in some sectors, it also creates new opportunities for job creation in others. This is because digital technologies can enable the creation of new products and services, leading to the emergence of new sectors and business models (Aksin-Sivrikaya, & Bhattacharya, 2017).

As found during this analysis, the upheavals brought about by digitization have both positive and negative effects on the community (Aksin-Sivrikaya, & Bhattacharya, 2017). For this reason, it is essential to consider the issue of digitization in relation to that of sustainability and specifically, to social sustainability. Indeed, social sustainability refers to the ability of a society to meet its current needs without compromising the ability of future generations to meet their own needs (Bigliardi, & Filippelli, 2022). It involves ensuring that social, economic, and environmental systems are aligned in a way that promotes long-term well-being and prosperity for all members of society (Bigliardi, & Filippelli, 2022).

Digitization can contribute to social sustainability in several ways. First, digital technologies can improve access to education, healthcare, and other essential services, particularly in underprivileged communities (Senbekov et al., 2020). For example, telehealth can allow patients in rural areas to access medical care remotely, while online educational platforms can provide educational opportunities for people who may not have access to traditional educational institutions.

Secondly, digitalisation can promote social inclusion by reducing barriers to participation in the economy and society (Șerban, Moxon, Potočnik, Pasic, & Ștefan, 2021). For example, digital platforms can enable people to participate in the gig economy, offering new opportunities for income generation and entrepreneurship. Digital technologies can also facilitate the participation of

marginalized groups in the political process by providing a platform for their voices to be heard (Moutafidou, & Bratitsis, 2018).

Digitalisation has the potential to contribute significantly to social sustainability by improving access to essential services, promoting social inclusion, and enabling more sustainable production and consumption patterns. However, realizing these benefits requires a concerted effort to ensure that digitization is implemented responsibly and sustainably, considering the social and environmental impacts of these technologies (Aksin-Sivrikaya, & Bhattacharya, 2017).

The intent of this paper is to provide a systematic literature review to identify key themes and issues related to digitization and social sustainability. By reviewing the existing literature, we will develop a comprehensive understanding of research trends on the topic. Furthermore, to provide a more practical illustration of the concepts and ideas discussed in the literature review, we will also present a case study of a company that has successfully integrated digitalisation and social sustainability into its business model and vision. Through this case study, we will demonstrate how digitization can contribute to social sustainability and provide guidance for companies seeking to integrate these concepts into their operations.

Overall, this document aims to provide comprehensive and practical guidance for businesses and organizations seeking to leverage digitalisation to promote social sustainability, while also addressing the challenges and risks associated with this process. By combining theoretical insights with practical examples, we hope to provide a valuable resource for researchers, practitioners and policy makers seeking to navigate the complex and rapidly changing landscape of digitalisation and social sustainability.

2 Methodology

This section describes the methods used by the authors to achieve the objectives.

First, a systematic literature review (SLR) was conducted to provide a comprehensive overview of the academic research on digitisation and social sustainability. The SLR analysis was conducted using the cloud platform MySLR (My Systematic Literature Review) by implementing the principle outlined in (Ammirato, Felicetti, Rogano, Linzalone, & Corvello, 2022). We opted to utilize

Elsevier's Scopus as the scientific database for our search because it is a robust tool for measuring science (Bhimani, Mention, & Barlatier, 2019). Additionally, various materials that offer direction for systematic reviews of literature indicate that Scopus is a suitable database for this type of review (Bhimani, Mention, & Barlatier, 2019). The initial search query for Scopus was as follows (TITLE-ABS-KEY ("Digit*") AND TITLE-ABS-KEY ("sustainab*") AND TITLE-ABS-KEY ("Human resourc*") AND TITLE-ABS-KEY ("social*")). The research yielded 116 articles. Then, the search string was refined by incorporating the following criteria to align with the objectives of our review: the articles had to be written in English and published in journals indexed in the subject areas "Business, Management and Accounting," "Economics, Econometrics and Finance," "Computer Sciences," "Social Sciences," and "Decision Sciences." We thus obtained a dataset of 85 papers.

After the systematic literature review, a case study was considered to show possible links between digitalisation and social sustainability. The case study is based on a detailed survey instruments and interview on the topics covered in the paper, as better discussed in section 4.

3 SLR Analysis

The initial findings from the analysis highlight a growing interest in the investigated topic over time in research. Specifically, as shown in Figure 1, there was a 71.4% increase in literature on the topic in 2020. This is likely due to the Covid19 pandemic, which, as noted in the introduction section, has forced rapid digitalization processes. The interest in the topic continues to grow, with the latest complete data from 2022 showing almost double the number of publications from 2020 and 2021. This trend over time underscores the importance of digitalization and social sustainability today.

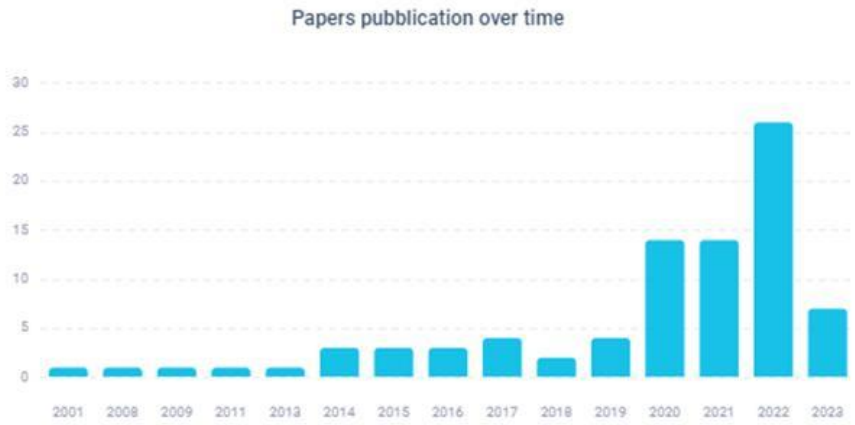

Figure 1. Published articles by year.

Through the MySLR platform, we analyzed the sample of papers to identify the main literature topics related to the theme of digitalization and social sustainability. Specifically, we utilized the "Latent Dirichlet Allocation (LDA)" technique, which outputs a set of k topics and a matrix that measures how much each article in the sample is linked to a specific topic (k) (Ammirato, Felicetti, Rogano, Linzalone, & Corvello, 2022). Figure 2 shows the LDA curve in blue as a function of the topics k. In the specific case at hand, we determined k=2, where the coherence value u_mass was -1.70 (Röder, Both, & Hinneburg, 2015) for the Gensim LDA algorithm. This value is indeed high enough to ensure the coherence of the topics (Chen and Liu, 2014) and to make the interpretation clear to the reader.

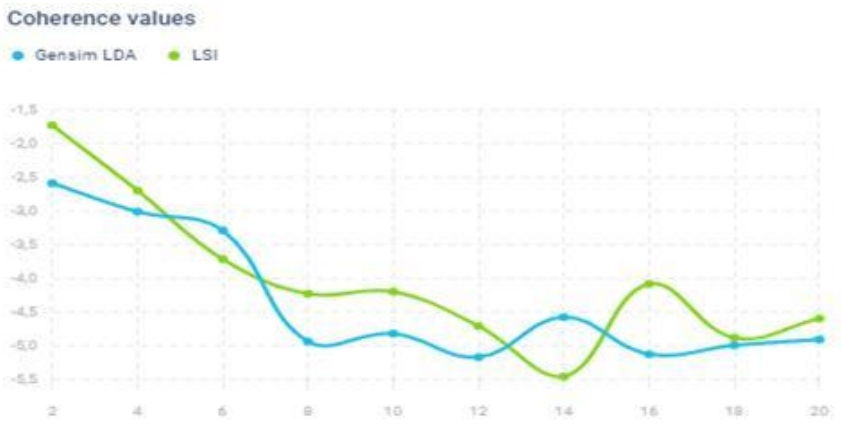

Figure 2. Coherence scores

Once we determined the correct number of topics, we analyzed each of the two clusters, assigning a name to the topics based on the relevant terms and documents associated with them by the MySLR platform. Table 1 reports the topic name, the relevant terms associated with it, and a list of sample documents that that we have established most representative for the topic.

A brief overview of the topics that emerged is shown below:

Table 1. Topic analysis

Topic name	**Relevant terms**	**References**
Digitalization and human resources processes	Digital, Human resources, human-machine interaction, employee	Kuzior, A., Kettler, K., & Rąb, Ł. (2022). Digitalization of work and human resources processes as a way to create a sustainable and ethical organization. *Energies*, *15*(1), 172. Libert, K., Mosconi, E., & Cadieux, N. (2020). Human-machine interaction and human resource management perspective for collaborative robotics implementation and adoption. Palumbo, R., Casprini, E., & Montera, R. (2022). Making digitalization work: unveiling digitalization's implications on psycho-social risks at work. Total Quality Management & Business Excellence, 1-22. Maier, M., & Vernim, S. (2021, December). Requirements for an Assistance System to Support Human Resource Development in Manual Assembly. In *2021 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)* (pp. 1372-1376). IEEE.
Innovation and Social Responsibility	Industry 4.0, technology, government, society, community	Lan Fang, M. (2022, June). Future of AgeTech: Transdisciplinary Considerations for Equity, Intersectionality, Sustainability, and Social Justice. In Proceedings of the 15th International Conference on PErvasive Technologies Related to Assistive Environments (pp. 536-541). Acioli, C., Scavarda, A., & Reis, A. (2021). Applying Industry 4.0 technologies in the COVID–19 sustainable chains. *International Journal of Productivity and Performance Management*, *70*(5), 988-1016. Sangwan, S. R., & Bhatia, M. P. S. (2020). Sustainable development in industry 4.0. *A Roadmap to Industry 4.0: Smart Production, Sharp Business and Sustainable Development*, 39-56. Shabib, M., Saberi, M., & Wadi, R. M. A. (2021). The Role of Digital Business in Achieving Generation Z Human Capital Sustainability. *Applications of Artificial Intelligence in Business, Education and Healthcare*, 39-67.

3.1 Digitalization and human resources processes

The ongoing digital transformation is impacting various sectors and functions within organizations, including Human Resources (HR) (Bigliardi, Filippelli, Petroni, & Tagliente, 2022). The integration of digital technologies into HR processes has become essential for organizations to improve efficiency, accuracy, and cost-effectiveness. The use of digital technologies in HR processes, also known as digital HR, has the potential to transform the way organizations manage their workforce (Sotnikova, Nazarova, Nazarov, & Bilokonenko, 2020).

Digital HR includes a wide range of technologies, such as cloud computing, big data analytics, artificial intelligence, and social media, which enable organizations to automate and streamline HR processes, improve data accuracy, and reduce costs (Sotnikova, Nazarova, Nazarov, & Bilokonenko, 2020).

Digitalization has had a significant impact on various HR processes, such as recruitment and selection, onboarding, training and development, performance management, and employee engagement (Sotnikova, Nazarova, Nazarov, & Bilokonenko, 2020). For example, digital HR tools such as applicant tracking systems and online assessments have improved the efficiency of recruitment and selection processes. Online onboarding programs have reduced the time and costs associated with new employee orientation. Digital learning platforms have enabled organizations to provide personalized and on-demand training to employees at a lower cost (Guragain, 2016).

The integration of digital technologies into HR processes offers several benefits to organizations (Fenech, Baguant, & Ivanov, 2019). First, digital HR can improve the speed, accuracy, and efficiency of HR processes. Second, digital HR can reduce costs associated with HR processes, such as recruitment, training, and performance management. Third, digital HR can improve the quality of data and analytics available to HR professionals, enabling them to make more informed decisions about their workforce. Finally, digital HR can enhance the employee experience by providing personalized and on-demand services (Fenech, Baguant, & Ivanov, 2019).

Despite the benefits of digital HR, organizations face several challenges in implementing digital HR). These challenges include resistance to change, lack of digital skills among HR professionals, data privacy and security concerns, and the need for significant investment in digital technologies (Zavyalova, Sokolov, Kucherov, & Lisovskaya, 2022). Addressing these challenges requires a strategic

approach to digital HR implementation, which includes assessing the organization's digital readiness, providing training and support to HR professionals, and ensuring compliance with data privacy regulations (Zavyalova, Sokolov, Kucherov, & Lisovskaya, 2022).

In conclusion, digitalization has transformed various HR processes, offering organizations the potential to improve efficiency, accuracy, and cost-effectiveness. However, the implementation of digital HR requires careful planning and management, as well as addressing several challenges. Organizations seeking to leverage digital technologies to enhance their HR processes should adopt a strategic approach, which includes assessing their digital readiness, providing training and support to HR professionals, and ensuring compliance with data privacy regulations. By doing so, organizations can realize the benefits of digital HR and stay ahead of the competition.

3.2 Innovation and Social Responsibility

The fourth industrial revolution, also known as Industry 4.0, is characterized by the integration of advanced technologies such as artificial intelligence, the Internet of Things (IoT), and big data analytics into manufacturing processes. Industry 4.0 represents a significant opportunity for businesses to innovate and improve their operations. Advanced technologies such as AI and IoT can help businesses streamline their processes, reduce costs, and improve product quality (Bigliardi, & Filippelli, 2022). However, while Industry 4.0 promises significant benefits for businesses, it also raises important questions about the role of technology in society and the responsibility of businesses towards the community. That is because these technologies also have the potential to displace workers and exacerbate social inequalities. To address these challenges, businesses need to adopt a socially responsible approach to innovation (Scavarda, Daú, Scavarda,& Goyannes Gusmão Caiado, 2019).

Businesses can demonstrate social responsibility is by engaging with the government and other stakeholders to ensure that the benefits of Industry 4.0 are shared across society. This can include investing in training programs and other initiatives to help workers adapt to the changing nature of work, as well as collaborating with policymakers to develop regulations that promote innovation while also protecting workers' rights (Scavarda, Daú, Scavarda,& Goyannes Gusmão Caiado, 2019).

Another important aspect of social responsibility in Industry 4.0 is community engagement. Companies need to be aware of the impact their operations have on the communities in which they operate and take steps to mitigate any negative effects. This can include investing in local infrastructure, supporting community initiatives, and engaging with local stakeholders to understand their needs and concerns (Mayes, McDonald, & Pini, 2014).

Finally, businesses also have a responsibility to ensure that their innovations are designed with social responsibility in mind. This means considering the potential impact of new technologies on society and taking steps to mitigate any negative effects. For example, businesses could prioritize the development of technologies that promote sustainability and reduce environmental impact (Mayes, McDonald, & Pini, 2014).

In conclusion, Industry 4.0 represents a significant opportunity for businesses to innovate and improve their operations. However, this must be done in a socially responsible way, with a focus on engaging with the government, society, and community to ensure that the benefits of innovation are shared across society. This requires a commitment to investing in the development of new technologies that promote sustainability and reduce social inequalities, as well as engaging with stakeholders to understand their needs and concerns. By doing so, businesses can demonstrate their commitment to social responsibility and help to ensure that the benefits of Industry 4.0 are shared across society.

4 Case Study

4.1 Survey and method

The case study presented was selected as a clear example of how digitalization can have a positive impact on social sustainability. In this section, we refer to social sustainability as the improvement of people's lives (in general, stakeholders) who benefit from the products and services generated by the company, as well as the possibility of creating new job opportunities. The ability to have paid work contributes to improving people's quality of life as it is directly linked to reducing situations of disadvantage and social marginalization.

The purpose of this analysis is to provide an evaluation of the possible impact of new digital business models on social sustainability. Specifically, the case study presented was considered capable of contributing to improving social

sustainability by placing people at the centre of interest, both as beneficiaries of a product/service and as workers.

The study was conducted through an in-depth interview based on a survey of research. The two main themes investigated concern the relationship of the company between digitalization and social sustainability. Through the investigation proposed below, we aim to identify whether there are conditions that allow for the coexistence of digital products and services with a vision of social sustainability that can generate profit for the company.

The following analysis has some main limitations:

1. Evidence derived from a single case can provide some indications but cannot have general validity.
2. The company operates in the Republic of San Marino, a small territory with specific socio-economic characteristics.
3. The economic sector in which the company operates is the healthcare sector, with different characteristics and needs depending on the specific territory.

This case study, therefore, can provide only some initial evidence with respect to the topic under discussion. To be able to attribute general value to the evidence emerging from the analysis, some possible solutions to the limits identified above are proposed in table 2:

Table 2. Case staudy's limits and solutions

Limits	**Solutions**
Analysis of a single case	Integrate the analysis with the consideration of multiple companies.
Geographical area	Multiple case study involving countries with different socioeconomic characteristics.
Economic sector investigated	Analyze case studies of companies operating in different economic sectors could be considered.

4.2 The Company

The case study analyzes a company located in the Republic of San Marino operating in the healthcare and social assistance sector. The company, established in 2021, studies and analyzes private and public healthcare realities, therapies, and medical-patient dynamics to find modern solutions to increasingly complex needs through advanced technologies.

The company was founded in response to a collective need, which became even more evident following the Covid-19 pandemic. They develop telemedicine platforms, apps, and software to support doctors and patients. One of the main advantages of using these products and services is the ability to monitor the progress of patients' illnesses remotely and accurately. The company is also involved in interactive training, aimed at helping customers make the most of the proposed innovative digital solutions.

In addition, the firm is classified as a "highly innovative startup" within the business registry, which is issued by a national agency called "San Marino Innovation" which has the task of verifying whether the San Marino companies meet one or more of the following requirements:

1. Development of new technologies, to provide products and/or services (internal development).
2. Adoption of new technologies (i.e., artificial intelligence, machine learning, blockchain, etc.) in business processes (external adoption).
3. Adoption of innovative solutions regarding one's own business model, product, service.
4. The requirement of substantiality is considered satisfied in the event of full compliance with the conditions indicated in the above article.
5. Solidity and consistency of the business plan included in the Certification Program presented by the User.

Another characteristic element of the company is represented by its mission aimed at social sustainability. The founders argue that the latter is one of the main reasons why they have undertaken this type of activity.

4.3 Evidence and implications of the study

The company under study presents growing development data. It should be noted that positive profits have been obtained starting from the year of its establishment. Moreover, balance sheet data comparing 2021 and 2022 show a growth in both turnover and profitability of almost 27%. Another point of analysis is the increase in the number of employees (100% from 2021 to 2022). This has had a positive impact on employment opportunities in the area and demonstrates how the company's object is in line with its vision. Specifically, it emerges that a business that produces digital products and services with a mission of social

sustainability can achieve positive business performance results quickly (only two years of activity).

If confirmed by further studies, these indications could be taken into consideration in the creation of new business models. The policies of different countries could also favor the birth of digital businesses with a vision of social sustainability. One possible interpretation emerging from the study is that companies that focus on creating new jobs with products/services that increase collective well-being contribute to a double benefit for social sustainability. This applies not only to new companies but can also be considered for the development or implementation of existing companies that can expand or diversify their business.

The evidence from the case study is summarized in Figure 3:

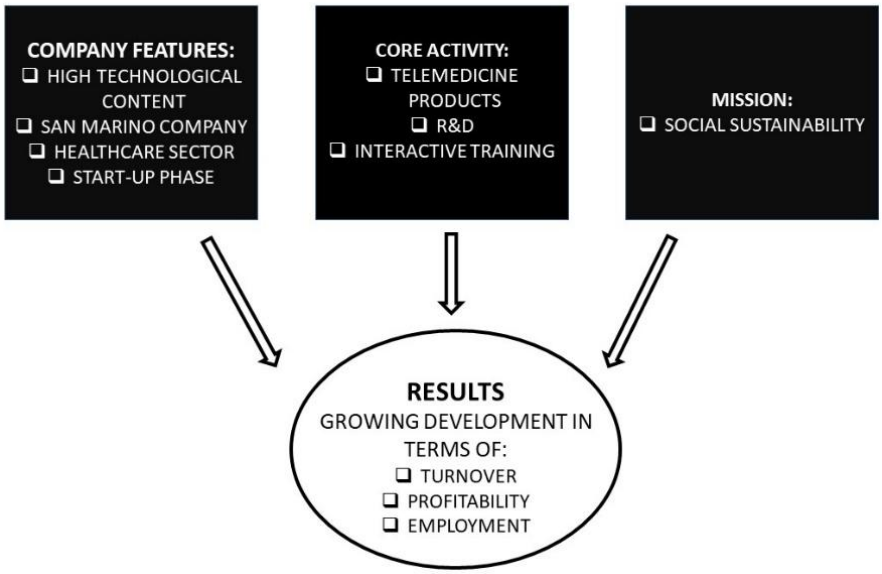

Figure 3. Evidence from the case study

5 Conclusion

Our findings highlight the importance of integrating social responsibility into digital strategies to ensure sustainable growth and development. We shed light on two critical research topics related to digitalization and social responsibility. Our systematic literature review identified two current areas of research interest:

1. Digitalization and human resources processes

2. Social Responsibility and Innovation.

In addition, our case study analysis confirmed that companies with a strong social sustainability mission that create digital products and services can experience rapid growth in profitability, revenue, and employment opportunities. Therefore, we suggest that managers focus on developing digital strategies that align with their organization's social responsibility mission.

Future research should explore the proposed solutions in table 2. Furthermore, researchers should identify strategies for managing potential risks and challenges associated with digitalization and social responsibility.

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Collaborative Network Formation in Robotics Digital Innovation Hubs: A Dynamic Capabilities Perspective

Jorge Tiago Martins

VTT Technical Research Centre of Finland
Tekniikantie 21
02150 Espoo, Finland

Abstract

The field of robotics has witnessed unprecedented growth in recent years, with emerging technologies such as AI, machine learning, and the Internet of Things (IoT) transforming the industry. To capitalise on this growth, manufacturers are turning to collaboration opportunities with digital innovation hubs, to foster collaboration, experimentation, and learning in the field of robotics. However, the success of such hubs depends not only on individual capabilities but also on their ability to work together as a network. In this context, the constitution of a network of digital innovation hubs operating in the domain of robotics raises important questions about the role of dynamic capabilities in the formation and development and of the network. Dynamic capabilities are traditionally considered to be the ability of organisations to adapt to changing environments and markets by leveraging their resources and capabilities. In the context of a nascent pan-European network of digital innovation hubs focused on robotics in manufacturing, it is proposed that the dynamic capabilities of the network at a system level will play a critical role in the network's development and activities. It is also important to acknowledge that effective knowledge management can enhance dynamic capabilities by allowing the network to leverage existing knowledge and acquire new knowledge to adapt to changing environments. This paper, focusing empirically on the analysis of DIH^2 – a nascent network of digital innovation hubs operating in the domain of manufacturing robotics, examines how dynamic capabilities can be developed and leveraged to contribute to the overall success of the network. Overall, the paper aims to contribute to the growing literature on dynamic capabilities by examining their role in the constitution of a network of digital innovation hubs in the domain of manufacturing robotics. By highlighting the importance of knowledge management in the development of dynamic capabilities, the paper provides insights that can inform the design and management of successful digital innovation hub networks, in cognate domains.

Keywords – Digital innovation hubs, Dynamic capabilities, Inter-organisational network

Paper type – Academic Research Paper

1 Introduction

Regions across Europe have been challenged to deliver digital solutions to small and medium size enterprises (SMEs), through mechanisms that respond to the challenges of complex, multi-layered innovation ecosystems. Under the framework of Digital Innovation Hubs, the configuration for the provision of such services has moved away the establishment of individual initiatives into integrative, regionally grounded hubs that operate as multi-stakeholder entities deploying one-stop-shop services in the form of supporting companies in their technical, business and ecosystem development support needs (Butter et al., 2020).

A key underlying expectation sustaining the operation of digital innovation hubs concerns supporting technology transfer from science to industry, enabling the resource and capacity sharing among firms, and supporting life-long learning of industry workers (Lanz et al., 2020). In this sense, digital innovation hubs support knowledge, technology and competence transfer across European SMEs.

While recent, the development of digital innovation hubs as a policy initiative, corresponds to a structured collaboration environment comprising groups of diverse stakeholders (governmental agencies, industry associations, large companies, SMEs, start-ups, investors, corporations, extension, accelerators, incubators, universities, research centres, specialised experts) that are connected in collaborative and supportive relationships (Zamiri et al., 2021). The collection of collaborative practices is intended to help companies become more competitive vis-à-vis business/production processes and the ability to develop customised products and services.

Crupi et al. (2021) call for further research into how digital innovation hubs act as knowledge brokers (for instance mobilising knowledge to identify performance gaps and assess SMEs level of digitalisation); helping beneficiary firms adopt open innovation practices through overcoming limitations in internal resources; and mediating interactions between previously unconnected actors for the exploitation and exploration of innovation opportunities.

Indeed, the current digital transformation of manufacturing is occurring at an unprecedented rate and manufacturing SMEs are faced with a new set of digital requirements and competitive challenges involving technical transformation, adaptation to customer expectations, environmental sustainability, amongst others. This emerging reality means in practical terms that many regions across

Europe need tailor-made initiatives and policies to take advantage of competitive strengths and expertise. The DIH² Network is a pan-European response to this transformation, created to make expertise in robotics and cognitive manufacturing accessible to local industry.

Established under the Horizon 2020 Industrial Leadership programme, DIH² is a nascent network of digital innovation hubs. Its core mission is to accelerate sustainable growth in European manufacturing through facilitating access to and development of new robotics solutions to SMEs, who often lack the resources to manage the digital transformation of their businesses. A key role of the DIH² Network is therefore to ensure SMEs are able to leverage the benefits of deploying robotics in manufacturing, including working in partnership with technology providers, research and technology organisations and other stakeholders.

While there is a proliferation of manufacturing-focused networks, the DIH² Network is unique in its approach to industry transformation through aggregating European digital innovation hubs into a structured collaborative environment. Comparatively, the operationalisation of how such collaborative networks can be designed remains limited, so the approach implemented by the DIH² Network exemplifies how the complexity of addressing the knowledge gaps in the transfer of robotics into manufacturing SMEs calls for creative solutions.

Drawing the dynamic capabilities literature and how it intersects with knowledge management, this paper discusses and theorises the key factors that trigger the formation of the DIH² collaborative network, the motivations of participating organisations for forming a network, and the sensing, seizing and transforming mechanisms employed to form and develop the DIH² collaborative network. The subsequent sections review the literature that forms the conceptual framework, introduce the research methodology, and present the findings of the study. Finally, the paper concludes with a discussion of findings and the identification of practical and managerial implications.

2 Conceptual framework

The concept of dynamic capabilities concerns the mechanisms (sensing, seizing, reconfiguring), through which organisations can adapt and respond to changes in their environments (Teece, 2007). It was initially applied to single organisations, with a focus on the internal processes and resources that enable firms to identify

and exploit new opportunities. Sensing is the ability to detect and interpret changes in the business environment, including market trends, customer needs, technological developments, and regulatory shifts. Organisations with strong sensing capabilities are able to identify emerging opportunities and threats, and to adjust their strategies accordingly. Seizing refers to ability to quickly and decisively capitalise on opportunities, whether by developing new products and services, entering new markets, or acquiring strategic assets. Organisations with strong seizing capabilities are able to move swiftly and confidently, and to take calculated risks in pursuit of strategic goals. Finally, reconfiguring he ability to continuously adapt and reconfigure organizational resources and capabilities to meet changing market and environmental conditions. Organisations with strong reconfiguring capabilities are able to integrate new resources and capabilities, shed those that are no longer useful, and effectively manage organisational change.

However, as the business environment has become increasingly complex and interdependent, the concept of dynamic capabilities has evolved to include the management of networks and network orchestration. Network orchestration (Linde et al., 2021) refers to the coordination and management of a group of firms that collaborate to achieve a common goal. In the context of network orchestration, dynamic capabilities are no longer confined to the individual organisations within the network. Instead, they extend to the network as a whole, and the ability of the network to adapt and respond to changes in the environment. In this way, dynamic capabilities are seen as a critical factor in the success of networked organisations.

Foss et al. (2023) explore the concept of ecosystem leadership as a dynamic capability, and its potential to drive innovation and growth in complex, networked environments. Ecosystem leadership is a key dynamic capability for organisations operating in complex, networked environments. It is defined as the ability to effectively manage and lead a network of partners, suppliers, customers, and other stakeholders to achieve shared goals and outcomes. This typically requires a unique set of skills and competencies, including the ability to collaborate and co-create with partners, manage complex relationships, and drive continuous innovation and learning. Successful ecosystem leadership requires a systemic approach that emphasises the interdependent relationships between different actors and components of the ecosystem. This calls for a deep understanding of the ecosystem, its dynamics, and the different roles and contributions of the

various actors involved. Finally, ecosystem leadership can drive innovation and growth by enabling organisations to access new sources of knowledge, resources, and capabilities, and by facilitating the development of new products, services, and business models.

Relatedly, Linde et al. (2021) argue that the dynamic capabilities framework can be used to develop a capability-based approach to ecosystem orchestration, which involves the coordination of a range of resources and capabilities, including technological, organisational, and institutional resources. They propose four key dynamic capabilities that are essential for ecosystem orchestration: sensing and shaping opportunities, integrating and coordinating resources, learning and adapting, and leading and governing. Such capabilities can be developed through a range of mechanisms, including strategic partnerships, organisational structures, and leadership development. The importance of knowledge management is also emphasised, especially in developing dynamic capabilities for ecosystem orchestration, as knowledge management processes are acknowledged for supporting the development of the sensing and shaping opportunities and learning and adapting capabilities, enabling organisations to identify and respond to changes in their environments.

Adopting a systems thinking perspective, Sunder and Ganesh (2021) call for a more comprehensive understanding of the dynamic capabilities ecosystem, which consists of various components such as knowledge management, learning and innovation, culture, strategy, and leadership. These are interdependent components, which must be managed holistically to develop and sustain dynamic capabilities. Therefore, a framework for identifying and analysing the components of the dynamic capabilities ecosystem is proposed. The framework includes four stages: (1) identifying the key components of the ecosystem, (2) mapping the relationships and interdependencies between the components, (3) identifying the feedback loops and their impact on the ecosystem, and (4) developing strategies to manage the ecosystem and build dynamic capabilities. Crucially, knowledge management processes support learning and innovation, which are critical components of dynamic capabilities. In addition, a culture of knowledge sharing and collaboration is necessary to support the development and implementation of dynamic capabilities. This argument is also put forward by Easterby-Smith and Prieto (2008), who propose that dynamic capabilities and knowledge management are interrelated concepts, and that learning plays a critical role in integrating these two concepts. In that sense, dynamic capabilities involve the

ability of organizations to learn, innovate, and adapt to changing environments. The key dimensions of dynamic capabilities are closely linked to knowledge management, as knowledge management can provide the resources and capabilities necessary for dynamic capabilities to be developed and sustained.

3 Methods

Making use of the DIH² network bi-weekly meetings, four ninety-minute focus group (Morgan and Spanish, 1984) discussions provided thirty-seven participants – individual digital innovation hub representatives designated as local evangelists in robotics (LERs) – with a unique opportunity to get acquainted with the other stakeholders involved in the DIH² Network, express their needs and what they offer, as well as how they are positioned in relation to each other. Through this, the network had the chance to reflect, justify decisions, question choices and placement of proposed actions. All participants had equal opportunities to ask questions and provide feedback. This reflection encouraged collaborative and iterative development of the network. The focus group discussions were audio-recorded and the qualitative data was analysed using inducting thematic analysis (Braun et al., 2006).

During the focus group discussions, LERs were invited to share snippets from their own experience of the DIH² network, focusing on what it should stop doing, what it needs to continue doing, what it needs to do more or less of, and what it needs to start doing that it hasn't already done. Once it was possible to take stock of the challenges impacting what LERs think are the critical activities of the network, the analysis focused on a smaller number of challenges, thinking about them and organising them in terms of their importance and achievability. Finally, there was an opportunity for focused discussion of the root causes of perceived challenges and to brainstorm and propose possible solutions concerning network vision and governance.

4 Findings

The workshops produced a comprehensive and detailed mapping of challenges for the different activities of the DIH² Network, as well as a prioritisation of activities, so that the network could attain a more refined focus of action. Table 1 below presents the results outlining role, challenges (and their causes) and solutions the DIH² Network is positioned to deliver.

Table 1 – Roles, challenges and solutions the DIH² Network is positioned to deliver

Roles	Challenges	Causes	Solutions
Innovating	How to present new technology to SMEs who might be sceptical to new services/ solutions	Lack of awareness. No success stories. Lack of technical skills.	Showcase of technology implementation
	Engaging with industry needs: taking a listen/ select, take action/ adapt approach	Diversity of industrial IoT protocols	Adapting the business model of the network to market needs
Connecting	Generating trust	Bureaucracy; security and privacy issues. Staff competences	Certification of experts and platforms used
	Insufficient visibility of services provided by each digital innovation hub and respective ecosystem	Distinguishing good/ standardised information. Social interaction to overcome misinformation	Clear and translated to market messages. One-to-one meetings with SMEs
Celebrating	Building follow-up stories of successful use cases	Lack of trust on benefit and applicability of technological solutions	Appointing ambassadors for clear dissemination. Evaluating technology transfer experiments for demonstration of what was needed and how they succeeded
	Generating success stories of win-win experiences across network regions	Regional representatives don't know enough about the network and are not necessarily interested in R&D	Engage regional authorities in motivating companies to implement network resources/ practices
Advocating	Lack of clear communication material	Need to establish effective clear and meaningful impact indicators (social, economic, employment)	Fine-tune impact stories to specific target audiences (policy-makers, authorities, industrial associations)
	Being able to explain the benefits of good practices	Lack of meaningful key performance indicators	Determining economic and social impact key performance indicators to communicate best practices

Subsequently, conceiving the enactment of the network as a collection of activities, LERs focused their thinking around key challenges (synthesised in Table 2), which they consider to be at are at the core of the foundational ethos of digital innovation hubs, and by extension, of a pan-European network of digital innovation hubs operating in the domain of manufacturing robotics: funding, sharing knowledge, training, and convening and facilitating.

Funding refers to how to obtain the financing the network needs (operational continuity, membership fee structure, large research grants the network can collectively go for).

Sharing knowledge is about providing and sharing scientific knowledge, technical and practical know-how, information and business intelligence that can lead to enhanced innovation outcomes.

Training for innovation with robotics in manufacturing concerns doing things in new ways – so this requires developing new mindsets and capabilities. Therefore, training and capacity building refers to the technical domain but also to more general business and leadership skills.

Convening and facilitating and involves bringing the members of the network together and facilitating productive, mutually beneficial interactions – this can take the form of working groups, stakeholder workshops, thematic meetings and gatherings.

Table 2 – Enactment of the network as a collection of activities

Roles	**Challenges**	**Causes**	**Solutions**
Funding	Scalable solutions/ business models to attract private funding	Solutions on the market are too focused and are difficult to scale. When scaling up is possible there is insufficient communication	Developing flagship solutions that SMEs can relate to
	Translate knowledge into economic impact	Companies struggle with bridging the gap between low and high technology readiness level	Strengthen digital innovation hubs role in supporting technology transfer experiments, while encouraging companies to collaborate
Sharing knowledge	Emphasising quality and additional services offered	Differentiation difficulties when services in other platforms look similar	Developing service catalogue
	Providing an environment for	Lack of a centralised information platform for	Developing a centralised information platform for

	information exchange between digital innovation hubs	digital innovation hubs	digital innovation hubs, concentrating live news, and opportunities for collaborative work and projets
Training and convening	Make participation in events and coordination of events more accessible	Not many participants are reached. There are too many events on the same topic	Coordinate to develop joint events
	Demonstrating results, not documentation. Making more use of media stories and leadership by example	No real demonstrators. Overuse of presentations and no live demos	Develop videos demonstrating technology transfer experiments and live workshops showing results
Facilitating	Getting the right level of information on industrial IoT platforms and services	Descriptions are in inaccessible language. Insufficient information scares newcomers who have traditionally worked with specific industrial partners	Simplify documentation for end-users. Prepare information for user personals, highlighting what the gains/ benefits are, compared to competitors
	Demonstrating the added value of SMEs obtaining help from digital innovation hubs	SMEs not always recognise the added value	Use technology transfer experiments to present clear return on investment. Act as a consultant to SMEs concerning participation in projects and identification of funding opportunities

6 Discussion and conclusions

The identified roles of innovating, connecting, celebrating, advocating, funding, sharing knowledge, training, and convening and facilitating are all closely related to key components of ecosystem dynamic capabilities, especially the systems thinking perspective articulated in Sunder and Ganesh's (2021) construct of dynamic capabilities ecosystem, and the developing stages of identifying the key components of the ecosystem, mapping the relationships and interdependencies between the components, identifying the feedback loops and their impact on the ecosystem, and developing strategies to manage the ecosystem.

For DIH^2, "innovating" and "connecting" are essential dimensions for identifying the key components of the network. "Innovating" involves identifying new ideas

and technologies that can be integrated into the network, while "connecting" involves identifying the key actors and institutions that make up the network.

"Celebrating", "advocating", and "funding" are all relevant dimensions for mapping the relationships and interdependencies between the components of the ecosystem. "Celebrating" involves recognising and promoting the successes of the ecosystem, while "advocating" involves promoting the ecosystem to external stakeholders. "Funding" is also essential for mapping the relationships between the components, as it helps to identify the key sources of financial support for the network.

"Sharing knowledge" and "training" are essential dimensions for identifying the feedback loops and their impact on the network. "Sharing knowledge" involves promoting the exchange of information and ideas within the network, while "training" involves developing the skills and competencies of the actors within the "network".

"Convening and "facilitating" are relevant dimensions for developing strategies to manage the network. "Convening" involves bringing together actors within the network to collaborate and share ideas, while "facilitating" involves providing the necessary resources and support to enable the "network" to function effectively.

The dynamic capabilities of a network of digital innovation hubs are multidimensional, consisting of a range of interdependent roles that influence each other in complex ways. The implications of these findings for the theory and practice of managing a network of digital innovation hubs are significant. First, the roles proposed in the paper provide a useful tool for managers and policymakers to analyse and manage the dynamic capabilities of a network of digital innovation hubs. Second, the application of systems thinking in the analysis of the network can help to identify and address the feedback loops that exist within the network, which are critical to its sustainability and success. Finally, the findings highlight the importance of effective collaboration and coordination among the various actors and institutions involved in the network.

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The Role of Digital Technologies for Environmental, Economic and Social Sustainability in Supply Chain Management

Vincenzo Varriale*

Department of Industrial Engineering
University of Salerno
Via Giovanni Paolo II, 132, 84084 Fisciano (SA), Italy

Antonello Cammarano

Department of Industrial Engineering
University of Salerno
Via Giovanni Paolo II, 132, 84084 Fisciano (SA), Italy

Francesca Michelino

Department of Industrial Engineering
University of Salerno
Via Giovanni Paolo II, 132, 84084 Fisciano (SA), Italy

Mauro Caputo

Department of Industrial Engineering
University of Salerno
Via Giovanni Paolo II, 132, 84084 Fisciano (SA), Italy

* *Corresponding author*

Abstract

The technological choices facing organisations are increasingly complex and aimed at promoting sustainable development. Recently, the concept of Industry 5.0 has laid the foundations for a digital transformation that drives companies to adopt sustainable approaches. Although there are various contributions investigating the link between sustainable production and digital technologies, there is still a lack of comprehensive research on the role of digital technologies in achieving the three pillars of sustainability in specific areas of supply chain management (SCM). The article aims to assess and understand which digital technologies are the most promising for achieving sustainability standards. Through a systematic literature review, the study analyses 1,720 scientific articles that identify business practices supported by digital technologies such as: 3D

printing, artificial intelligence, blockchain, computing, digital applications, geospatial technologies, immersive environments, Internet of Things, open and crowd-based platforms, proximity technologies and robotics. Such business practices are thereafter associated with specific areas of SCM such as distribution, marketing and procurement. The results show that blockchain technology is promising for different sustainability aspects, whereas computing, 3D printing and immersive environments are less employed for sustainable development. The study also highlights that scholars have paid more attention to environmental rather than economic and social sustainability dimensions. The contribution of this article is to provide a current overview of digital technologies in SCM to clarify the state of the art of research. It also defines a research agenda for academics to conduct further exploratory research. For managers and practitioners, it presents a knowledge base where data on sustainable practices supported by digital technologies in SCM have been collected and organised, providing information to companies on opportunities for implementation in their own business.

Keywords – Digital transformation, sustainability, supply chain management, artificial intelligence, blockchain.

Paper type – Academic Research Paper

1 Introduction

Growing environmental, social and economic threats from pandemics, crises, wars, global warming and increasing poverty are accelerating many significant transformations in society and companies (Ajmal et al., 2022; Mishra and Singh, 2022). To survive in such increasingly complex and dynamic conditions, companies should necessarily innovate and adapt to new standards of efficiency and sustainability (Okorie et al., 2023). To increase and keep their competitive advantage, firms are promoting the adoption and integration of different technologies to ensure more efficient, flexible and agile systems (Felsberger et al., 2022; Latino et al., 2022). Scientific research has identified Industry 4.0 as the phenomenon in which digital technologies are interconnected to automate and optimise industrial processes (Baur, 2015). This paradigm allows companies to have more control over the entire product life cycle, from idea generation, through the development and production phases, to delivery to the final customer, after-sales services and waste management (Corallo et al., 2020). Scholars investigated specific digital technologies related to the Industry 4.0 paradigm - such as Internet of Things (IoT), blockchain, additive manufacturing, artificial intelligence (AI) - and their impact on organisations (Aoun et al., 2021;

Florén et al., 2021). The complexities of the technological choices facing organisations are even greater today because they should take into account the three dimensions of sustainability - environmental, economic and social - and promote sustainable development. In this context, research is converging on integrating the technological principles of Industry 4.0 with sustainability issues in SCM (Bajic et al., 2021; Seyedghorban et al., 2020). Therefore, the European Commission has created the Industry 5.0 agenda, which combines these two theories (Ghobakhloo et al., 2022; Maddikunta et al., 2022).

There are several contributions in literature that combine these two paradigms, however in a fragmented manner. Current studies consider the evaluation of single digital technologies at time, such as blockchain, AI or IoT, in specific SCM case studies or simulations to improve sustainability aspects (Chen, 2023; Tirkolaee and Aydin, 2022). Through literature reviews, other studies have focused on the analysis of the combined use of various digital technologies to improve sustainability in specific sectors (Liu et al., 2023). Other researchers developed conceptual frameworks linking the paradigm of Industry 4.0 and sustainable production by summarising existing research efforts and highlighting research gaps and opportunities (Sharma et al., 2021). Moreover, scientific research is pushing towards the links between Industry 4.0, digital technologies and the circular economy, providing an innovative view of the use of digital technologies (Rosa et al., 2020). Circular economy issues were further investigated by considering collaborative principles that can be developed by combining digital technologies in SCM (Gebhardt et al., 2021). Finally, most studies linking sustainability and digital technologies focus on specific business contexts such as new product development, lean manufacturing or life cycle assessment (Ahmed et al., 2020; Cifone et al., 2021).

Currently, there is still a lack of comprehensive studies investigating different digital technologies in specific business functions in supply chains from the environmental, social and economic perspective. Therefore, the purpose of this article is to increase the body of knowledge on sustainable business practices based on current digital technologies and to classify their use in specific SCM contexts. The gaps in literature led to the development of the following research questions:

1. Which digital technologies are more promising in promoting sustainable practices in SCM?

2. In which specific business functions does the adoption of digital technologies improve sustainability dimensions?

First, the study investigates and analyses which digital technologies are mainly adopted to improve business practices in SCM. To achieve this goal, the study considers eleven digital technologies: 3D printing, AI, blockchain, computing, digital applications, geospatial technologies, IoT, immersive environments, open and crowd-based platforms, proximity technologies and robotics. For each digital technology, business practices supported by their use in SCM were intercepted through a systematic literature review (SLR). Sustainable business practices are therefore identified considering the three sustainability pillars, i.e. environmental, social and economic. Such sustainable business practices were further classified into specific business functions for SCM such as marketing, distribution and procurement. Hence, the study provides a comprehensive overview of digital technologies that promote sustainable practices in SCM. This analysis contributes to the advancement of research on the role of digital technologies in supporting economic, social and environmental sustainability in SCM by providing researchers and academics with insights for future research. The article identified 1,720 peer-reviewed scientific articles featuring business practices based on digital technologies in SCM.

The rest of the document is structured as follows. Section 2 presents the digital technologies and business functions using a conceptual framework. Section 3 shows the research methodology conducted. Section 4 analyses the results. Section 5 presents the discussions, providing insights for future research. Conclusions close the paper.

2 Theoretical background

2.1 Digital technologies for SCM

There is no rigorous and detailed classification of current digital technologies in literature. The classifications between different studies are conflicting and there are several inconsistencies among the various authors. In 2015, Boston Consulting Group identified nine technologies for Industry 4.0: robots and autonomous vehicles, additive manufacturing, augmented and virtual reality, big data, simulation, IoT, horizontal/vertical systems integration, cloud technologies, blockchain and cybersecurity (Rüßmann et al. 2015). Some researchers divided

technologies into two categories: physical and digital technologies. The former includes sensors, drones, 3D printing and advanced robotics. The latter include information and communication technologies such as big data, blockchain, AI and cloud computing (Liao et al., 2017). Further studies used different taxonomies. For example, Dantas et al., (2021) classify technologies into IoT, cyber-physical systems, big data, Internet of Services, additive manufacturing, augmented reality, cloud computing, systems integration, cybersecurity, simulation and autonomous robots. Bai et al., (2023) identify the following Industry 4.0 technologies: 3D printing, AI, robotics, blockchain, cloud computing, cybersecurity, drones, industrial IoT, mobile technology, nano technology, RFID, simulation, sensors and actuators. With the development of the Industry 5.0 paradigm, other digital technologies were added such as cognitive cyber-physics, cognitive artificial intelligence, intelligent materials, augmented and mixed reality, 5g/6g technology, Internet of Everything, digital twin and adaptive robots (Maddikunta et al., 2022).

Table 1 shows the digital technologies considered in this study with a brief description of each.

Table 1. List of digital technologies considered.

Digital technology	**Description**
3D Printing	A method of assembling materials in sequential layers to create items from 3D model data to design different products and gain mass-customization.
AI	A system to think rationally and humanly that uses natural language processing, machine learning, and computer vision.
Blockchain	A shared, secure, transparent and distributed ledger in which transactions can be recorded.
Computing	System for providing online storage services on a virtual server.
Digital applications	Technologies that create virtual communication channels.
Geospatial tech	Technologies that geolocate and map objects and things on Earth.
Immersive environments	Technology that simulate elements of the real world, such as machines and people, in a virtual setting with the goal of making system design and live operation easier and more affordable.
IoT	Physical things and devices connected by an information network that allows data to be exchanged among them for interaction and cooperation.
Open and Crowd-Based Platforms	Technologies that favour the power of the crowd using shared digital platforms to achieve a common outcome.

Proximity tech	Technologies that measure the physical condition of systems through sensors.
Robotics	Equipment and machinery that automate operational procedures.

2.2 Business functions of SCM

There are several reference models in literature that classify the different business functions. One of the first models is provided by Porter (2011), where activities are divided into primary (e.g. operations, logistics, services, marketing and sales) and secondary (e.g. technology development, infrastructure, procurement, human resources management). Recently, this model has been further developed into two frameworks: Supply Chain Operations Reference (SCOR) and the Process Classification Framework (PCF). SCOR is based on five business processes - planning, procurement, production, delivery and return - whereas, the PCF model is based on twelve business processes classified into operational and support processes. Both aim to identify the best business practices to be adopted in SCM (Stewart, 1997). Considering these models, the study focuses on three core business functions for SCM, distribution, marketing and procurement. Distribution embraces all logistics activities such as transportation, delivery, inventory, reverse logistics, transportation and warehouses management. Marketing includes customer payment, customer service, after-sales service and sales channel. In procurement are included buyer-supplier relationships, order management, supplier evaluation and selection and supplier payment.

2.3 Framework conceptualization

Digital technologies can be used in different business processes, carrying out specific impacts. In some cases, they can be employed in a single business process; in others, they can be valuable in different business contexts. This research considers the inductive-deductive approach based on a conceptual framework according to Seuring and Gold, (2012). The framework clarifies the key factors that will be examined and the potential relationships between them (Liehr and Smith, 1999). To guide the research findings, the article is based on three elements: digital technologies, business functions and the three dimensions of sustainability. A similar approach was taken by Bai et al., (2023) who conducted a

literature review on the application of digital technologies for social sustainability. The framework proposed in Figure 1 integrates the elements presented above. It supports the understanding of the impact of digital technologies in specific business functions of SCM through sustainable practices. The centre of Figure 1 is the sustainability goal to be achieved by the support of digital technologies in SCM. The second level includes business functions in SCM. The third level identifies the 11 technologies considered. Although these technologies directly address the three pillars of sustainability, they are also explored in different supply chain processes.

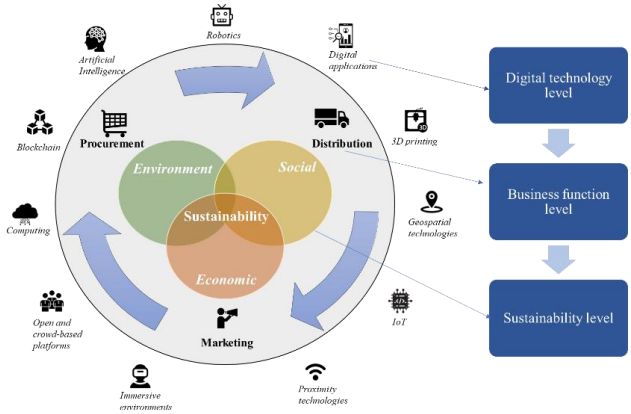

Figure 1. Conceptual framework.

3 Methodology

SLR was used in this study since it enables the identification, selection and critical evaluation of data included in scientific studies. It is a transparent, easily replicable and rigorous methodology and enables the selection of the most relevant articles in the field of research to provide a comprehensive view of the state of the art (Tranfield et al., 2003). The SLR involves four steps: problem identification, screening step, selection criteria (inclusion and exclusion criteria), and classification step. Figure 2 presents all the steps for the review.

3.1 Problem identification and screening phase

This work used Scopus as a database because it covers both scientific and humanistic disciplines (Moher et al., 2009). Table 2 shows the keywords used in the Title or Keyword of search string referring to each digital technology analysed. As current digital technologies were considered, the temporal analysis of the

articles is limited to the years 2019-2022. The articles considered belong to the Q1 and Q2 quartiles according to Scimago Journal Ranking and ISI Web of Science. The research area is limited to management, business, accounting, economics, finance and operations research. In the screening phase, 27,288 articles were identified.

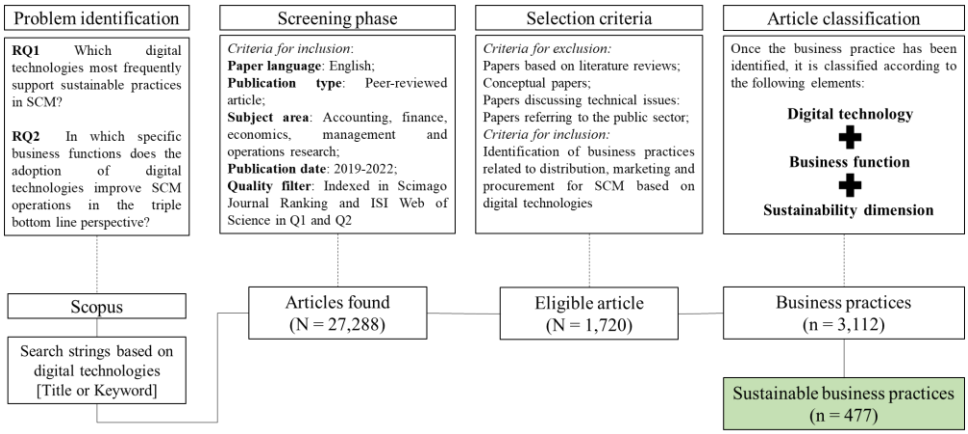

Figure 2. SLR steps.

Table 2. List of keywords.

Digital technologies	**Keywords**
3D Printing	3D printing; 3D printer; additive manufacturing; rapid prototyping; rapid tooling; bio printing; direct energy deposition; direct metal laser sintering; fused filament fabrication; fused deposition modeling; polyjet; powder bed deposition; selective laser sintering; stereolithography; blinder jetting
Artificial Intelligence	artificial intelligence; machine learning; metaheuristic; unsupervised learning; supervised learning; deep learning; computer vision; natural language processing; cognitive computing; artificial neural network; support vector machine; random forest; decision tree learning; genetic algorithms; reinforcement learning; convolutional neural network; speech technology; speech synthesis; speech recognition; speaker recognition; speaker verification; speech encoding; text-to-speech; speech-to-text; data analytics; data mining; data standardization; advanced analytics; predictive analytics; sentiment analysis; content analysis; text mining; user behavior analytics; user behavior analytics
Blockchain	distributed ledger; blockchain; cryptocurrency; smart contract; non-fungible token
Computing	cloud computing; cloud storage; fog computing, edge computing; quantum computing; cloudlet computing
Digital Applications	digital platform; digital application; digital traces; cron jobs; mobile application; social media; social network; web application; API; web service; robotic process automation; software bots; bots; digital signature; electronic

	signature; digital invoice; electronic invoice; digital contract; electronic contract; certified email; electronic storage; digital storage; substitutive storage; electronic document; digital document; digital certificate; electronic archive; digital archive; dematerialization; digitization; digital conservation; digital preservation
Geo-Spatial Tech	geo-spatial tech; geo-spatial intelligence; geographic information systems; global navigation satellite system; web mapping; remote sensing; global positioning system; spatial modeling
Immersive Environments	Augmented reality; digital twin; extended reality; gamification; mixed reality; virtual reality; metaverse; hologram; digital human
IoT	internet of things; smart sensor; wearable sensor; 5G; wireless sensors; LoRa; mobile sensing; Internet of Vehicles
Open And Crowd-Based Platforms	open science; open source; crowdsourcing; open data; crowd science; open access; crowdshipping; crowdfunding platform; open innovation platform
Proximity Tech	proximity tech; proximity sensor; beacon; RFID; near field communication; QR code; datamatrix; bluetooth; motion detector; biometric; gaze tracking; eye tracking
Robotics	robotic; industrial robot; service robots; cobot; drone; autonomous vehicle; driveless vehicles; autonomous mobile robot; autonomous technology; connected and automated vehicle; modular autonomous vehicles; shared autonomous vehicles; connected vehicle; automated vehicle; wearable robot; bionic robot; exoskeleton; AS/RS; social robot; robot-assisted gait training; robotics parcel lockers; robot-assisted surgery; unmanned ground vehicles; unmanned underwater vehicles; unmanned grounded vehicles

3.3 Article classification

Once eligible papers were identified, the team classified them according to the three elements of the research, i.e. digital technology, business function and sustainability dimensions. Figure 3 shows an example of a sustainable business practice where drones can be used in food delivery to improve demand response and reduce pollution (Hwang et al., 2020). Business practices are classified by assessing the technology and business context in which they are used to achieve a specific impact. This is a first classification filter. In this case, in the absence of sustainability-related improvements, they are counted as *business practices* (BP). When the business practice aims for an improvement at the sustainability level, they are counted as *sustainable business practices* (SBP). In this way, business practices are classified into the 11 identified digital technologies, into the three business functions of SCM and finally into the three pillars of sustainability (if any). The number of identified BPs using digital technologies in the SCM is 3,112. Whereas, the number of SBPs found is 477.

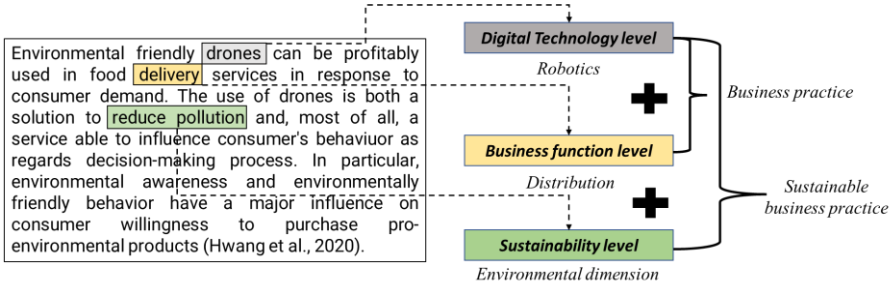

Figure 3. Example of SBP supported by drones.

4 Results

This section presents the results of the study. Table 3 shows the overall number of BP and SBP for each technology analysed in the SCM, together with the specific sustainability pillar. Figure 4 reports the overall number of BPs and SBPs: the most widely used digital technologies in SCM for sustainable operations are blockchain, IoT and AI, the least used computing, immersive environments and 3D printing.

Table 3. Distribution of BPs and SBPs for each digital technology.

Digital technology	Total BP	SBP	Economic	Environ-mental	Social
3D Printing	14	2	-	2	-
Artificial intelligence	728	62	6	46	10
Blockchain	367	85	26	34	25
Computing	119	26	7	12	7
Digital applications	466	44	10	21	13
Geospatial tech	169	51	6	35	10
Immersive environments	231	16	3	9	4
IoT	252	69	22	25	22
Open and crowd-based platforms	135	35	5	22	8
Proximity tech	323	49	15	19	15
Robotics	308	38	3	29	6

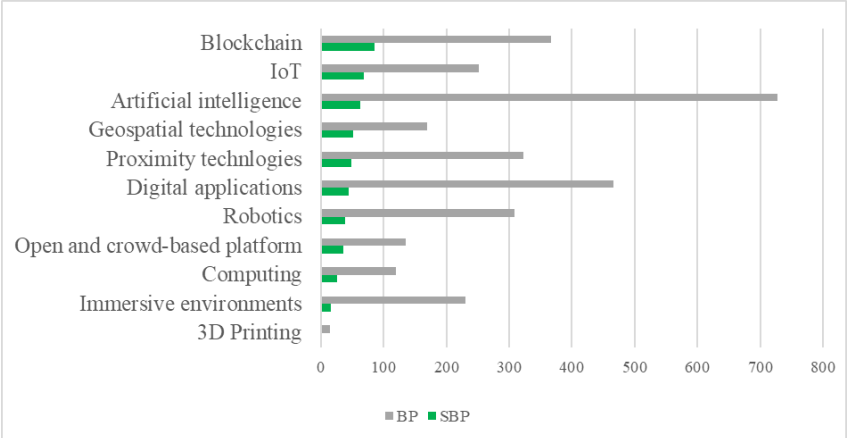

Figure 4. Digital technologies sorted in descending order of SBPs for SCM.

In Figure 5 data are further divided according to the three sustainability pillars. At the top of environmental BPs there are AI, geospatial technologies and blockchain, while in the top three places of social and economic BPs are blockchain, IoT and proximity technologies. At the bottom there are 3D printing, computing and immersive environments.

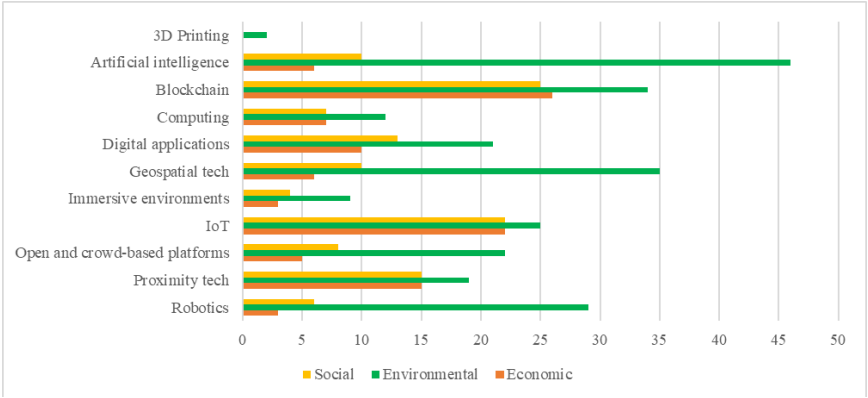

Figure 5. Count of the three dimensions of sustainability for each digital technology.

Table 4 and Figure 6 show how SBPs are distributed in the three SCM processes according to the three sustainability pillars: environmental practices are widely present in distribution, whereas, within procurement, SBPs are relatively evenly distributed across the three sustainability dimensions.

Table 4. Distribution of SBPs for each business function considered.

Business function	Economic	Environmental	Social
Distribution	36	144	42
Marketing	20	60	32
Procurement	47	50	46

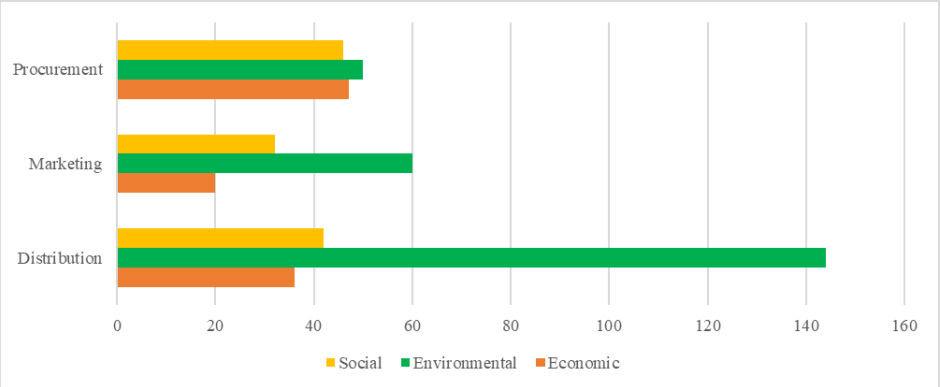

Figure 6. Count of SBPs for each business function considered.

Table 5. Distribution of SBPs for each digital technology and business function

Digital technology	Distribution			Marketing			Procurement		
	Economic	Environmental	Social	Economic	Environmental	Social	Economic	Environmental	Social
3D Printing	-	2	-	-	-	-	-	-	-
Artificial intelligence	3	25	4	2	13	5	1	8	1
Blockchain	7	10	7	3	7	3	16	17	15
Computing	2	6	2	2	3	2	3	3	3
Digital applications	1	7	1	5	12	8	4	2	4
Geospatial tech	1	19	2	1	8	4	4	8	4
Immersive environments	1	5	1	1	2	2	1	2	1
IoT	8	16	8	3	4	3	11	5	11
Open and crowd-based platforms	3	14	4	2	8	4	-	-	-
Proximity tech	7	13	7	1	1	1	7	5	7
Robotics	3	27	6	-	2	-	-	-	-

Table 5 shows the overall number of SBPs distributed according to each digital technology, business function and the three pillars.

Figures 7 to 9 report how SBPs are distributed in the three pillars for distribution, marketing and procurement respectively.

Results for distribution (Figure 7) highlight how the most widely used technologies in environmental practices are robotics, AI and geospatial technologies, while, from both social and economic perspectives, the most widely deployed technologies are blockchain, IoT and proximity technologies. The least employed technologies in distribution are 3D printing, computing and immersive environments. Furthermore, no economic and social BPs have been found for 3D printing.

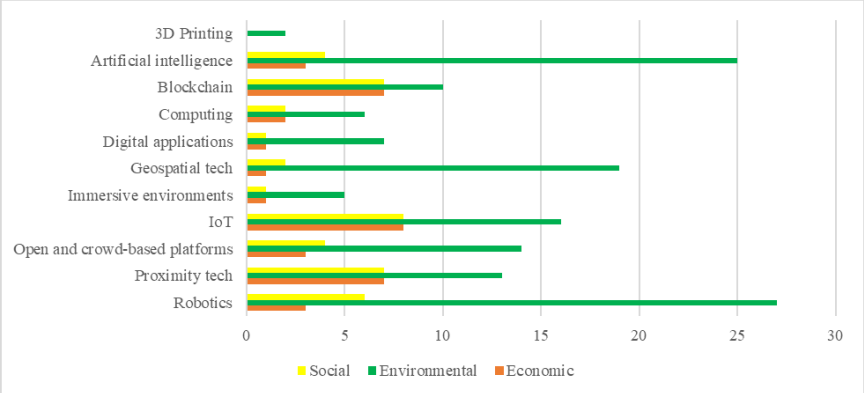

Figure 7. Count of SBPs for each digital technology in distribution.

As to marketing (Figure 8), the most used technologies in environmental and social BPs are AI, digital applications, geospatial tech and open and crowd-based platforms. On the economic side, the most employed technologies are digital applications, blockchain and IoT. At the bottom there are 3D printing, for which there are no SBPs, and robotics, for which there are no economic and social BPs.

In the case of procurement (Figure 9), the technologies most used in environmental practices are blockchain, AI and geospatial technologies. From the economic and social perspective, the most employed technologies are blockchain, IoT and proximity technologies. No SBPs were found for 3D printing, open and crowd-based platforms and robotics.

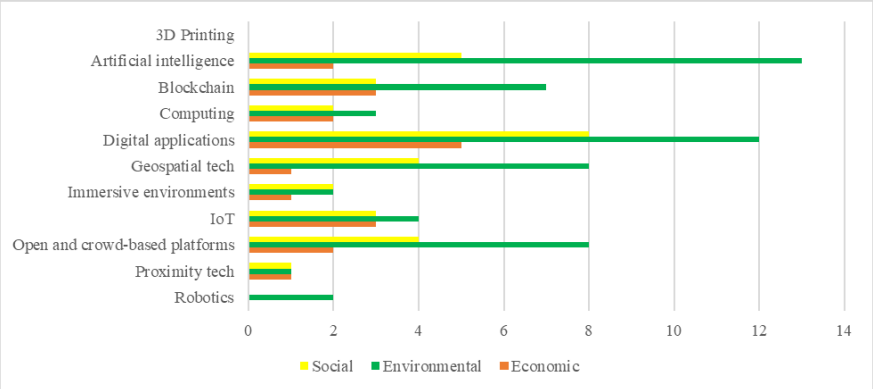

Figure 8. Count of SBPs for each digital technology in marketing.

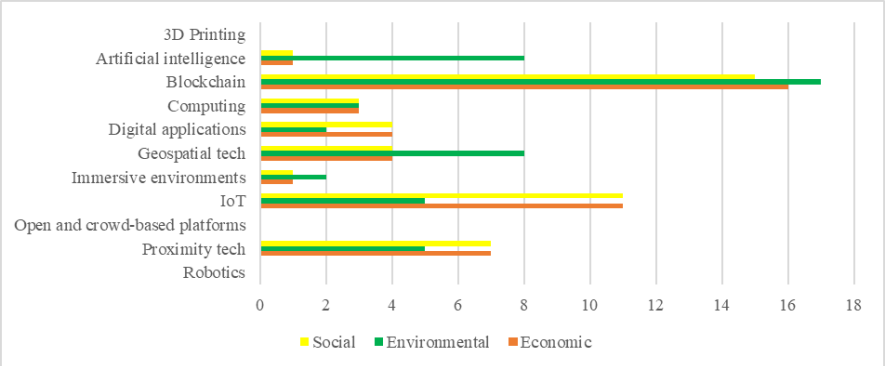

Figure 9. Count of SBPs for each digital technology in procurement.

5 Discussions

This section aims to discuss the results achieved by answering the initial research questions and providing further implications for the academic debate. Specifically, the role of digital technologies in sustainable operations management in SCM will be addressed. In addition, further considerations will be carried out regarding the specific business context in which digital technologies are employed. In addition, the article aims to provide a research agenda for academics and researchers. Finally, the study highlights the implications for managers and practitioners and the limitations of the study.

5.1 Digital technologies for SCM

The analysis conducted revealed some interesting insights into digital technologies in SCM in SBPs. Interestingly, blockchain has the highest number of SBPs. Although public blockchain has been severely criticised for its high energy consumption (Alshahrani et al., 2023; Sedlmeir et al., 2020), it has been considerably analysed for sustainable operations management. The results of this study are in line with the high number of articles in the scientific literature demonstrating the importance of this technology in sustainable SCM (Rejeb et al., 2023; Yontar, 2023). In general, blockchain, IoT and AI are considered helpful technologies for sustainable operations management, as they improve transparency, efficiency and security. For example, blockchain can be used to trace the origin and quality of products along the supply chain. This improves transparency and traceability, reducing the risk of fraud and counterfeit products. IoT can monitor the functioning of the supply chain through networks of sensors and data that promotes real-time information on logistics and product distribution, avoiding inefficiencies and issues. The implementation of AI supports distribution planning, optimises stock management and reduces waste of raw materials and energy. Although 3D printing, cloud computing and immersive environments are supportive technologies in many areas of SCM, they have not yet been totally integrated and addressed by scholars in sustainable operations management for several reasons. For example, 3D printing is still a relatively new and expensive technology. It is not yet an efficient solution to produce high quantities of products sustainably. The adoption of cloud computing in SCM may be slowed down by data security and regulatory compliance concerns such as data privacy regulations. Moreover, virtual and augmented reality are considered 'niche' technologies. They may have potential for implementation to improve sustainable aspects of SCM such as efficient warehouse management. However, the complexity and cost of implementation may slow down their use in SCM in the next decade. It should be noted that for some technologies the overall number of BPs is higher such as AI, digital applications, and proximity technologies. However, little scientific research has analysed these digital technologies in SCM from a sustainability perspective. The difference between the overall BPs for blockchain and those are only sustainable in SCM highlights how this technology can be promising for corporate social, economic and environmental responsibility.

Analysing digital technologies in more detail considering the three dimensions of sustainability, it is interesting to note that robotics and geospatial technologies are mainly used for environmental aspects. It is well known that Geographic Information Systems (GIS) aid transport planning and route optimisation through the visualisation and analysis of geographical data. This contributes to reduce costs and greenhouse gas emissions. Instead, robotics support the efficiency and safety of the supply chain for the collection and transport of materials and waste management. In addition, RFID technologies can improve economic and social aspects to identify and monitor objects in real time allowing better processes planning and coordination. Furthermore, from a social perspective, RFIDs can prevent counterfeiting and ensure product safety.

5.2 Digital technologies for marketing, procurement and distribution in sustainable operations management

The results of the study delve into the second level of the conceptual framework related to business functions. It is evident that SBPs are present more in distribution and less in procurement, indicating that scholars have strongly focused on the use of digital technologies in certain business functions. In distribution, the technologies most used in SBPs, especially environmental ones, are robotics and AI. For example, robots can automate sorting and packaging processes, reducing the time and cost of handling goods. Furthermore, AI can be used to optimise delivery routes and workload, improving efficiency and reducing environmental impact. In distribution, the most adopted technologies are IoT and blockchain to support economic and social BPs. For example, the distributed ledger allows all actors in the supply chain to access information in real time and verify the provenance, quality and product sustainability. IoT supports retailers to better monitor and manage their production and distribution processes, reducing waste and increasing efficiency. However, the results strongly emphasise that the use of digital technologies is mainly used in environmentally oriented BPs and less in social and economic aspects.

In marketing, there is a preponderance of BPs based on digital technologies that support environmental sustainability. However, prominent among these is the use of digital applications and open and crowd-based platforms. The former reduces dependence on traditional marketing activities that require the production of printed materials or the realisation of physical events, which can

have a negative environmental impact. Mobile applications, websites and social media enable more efficient and effective customer engagement by personalising customer communication and obtaining real-time feedback. The latter allows companies to interact with their customers in a direct and transparent manner, promoting dialogue and ideas exchange. In this way, companies can obtain faster feedback on their products and services, co-create new products and services with their customers, and promote sustainable practices through the sharing of information. They can reach a wider, heterogeneous audience by promoting their products and services through digital content and viral marketing campaigns. However, it is evident that some technologies have received less attention such as 3D printing and robotics. Some of these technologies have been less applied in this specific area of SCM and their potential impacts are unknown.

Compared to previous business functions, for procurement there is a preponderance of social and economic BPs in most digital technologies over environmental ones. The reason is that digital technologies can help companies improve transparency and traceability in managing their suppliers. For example, blockchain can enable companies to monitor and evaluate the performance of their suppliers in terms of regulatory compliance, corporate social responsibility, quality of products and services provided. The use of data analytics tools can help companies identify inefficiencies in supplier management and implement corrective actions to improve SCM performance.

5.3 Research agenda

The analysis conducted reveals several research gaps. For example, not all digital technologies mentioned are useful and available for achieving the three sustainability pillars. Moreover, several digital technologies analysed are not widely used in the business case studies collected. There are several reasons behind them. The first reason is that the digital technologies considered are relatively new and innovative, so their potential impacts on sustainable development in SCM are unknown. In some cases, the implementation of specific digital technologies has little success in managing operations. Probably, they mainly aim at maintaining a competitive advantage but neglect sustainable development issues. Researchers, managers and practitioners have not yet adopted certain technologies in the marketing, procurement and distribution functions and do not study their potential. The study shows that technologies

such as computing and immersive environments are less used for sustainable development. Being relatively new technologies there is limited awareness of their use and effectiveness for sustainable development. Finally, not all business contexts have been identified. For example, the various supporting business functions were not considered in this study.

5.4 Managerial implications and limitations

The results of this research are useful for managers and practitioners. Firstly, it indicates which technologies should be used within the company to improve sustainable SCM performance. The article presents a knowledge base in which data on sustainable emerging practices supported by digital technologies in SCM have been collected and organised, providing information to companies on opportunities for implementation in their business. Furthermore, it provides clear and valuable guidelines on what opportunities digital technologies can offer for sustainable supply chains. The article aims to assist managers in increasing the adoption rate of digital technologies in SCM to manage operations from a sustainable perspective.

The SLR has certain limitations. Firstly, the study is based on the analysis of scientific articles for the literature review. Therefore, it is impossible to state that all applications were considered. Furthermore, other research databases such as Web of Science were excluded. A further limitation is the lack of inclusion of grey literature such as web information, reports and conference articles. To support the continuous updating of this knowledge base, a high level of effort is required to read, classify and update sustainable practices by the group of industrial engineers. The challenges and barriers that slow down the adoption of these digital technologies in SCM have not been considered.

6 Conclusions

The study provided a comprehensive overview of the use of digital technologies in SCM to improve BPs from a sustainability perspective. The conducted analysis identified 1,720 articles from which 3,112 BPs and 477 SBPs were extracted. The research provides interesting insights as it investigates the contribution of digital technologies in various areas of SCM and identifies which technologies are particularly focused on the sustainability side of operations management. This paper contributes to the state of the art of the academic

debate by defining the boundaries of current research and proposing potential future research directions. It is crucial a further exploration of these topics to achieve the goals outlined in the UNO 2030 Agenda.

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Open Processes of Knowledge in Circular Enterprises

Sofia Mauro*

University of Naples L'Orientale
Largo S. Giovanni Maggiore, 30
Naples, Italy

Alessandra De Chiara

University of Naples L'Orientale
Largo S. Giovanni Maggiore, 30
Naples, Italy

Luigi Sergianni[1]

University of IUSS Pavia
Corso Strada Nuova, 65
Pavia, Italy

Anna D'Auria

University of Naples L'Orientale
Largo S. Giovanni Maggiore, 30
Naples, Italy

* *Corresponding author*

Abstract

The circular economy (CE) is experiencing increasing attention, as it has the potential to move away from unsustainable production and consumption patterns, such as the linear one. The circular innovation has even more considered an approach to be adopted in pursuing the sustainable development goals, embracing environmental, social and economic nature of sustainability.
Starting from the above premises, our study aims to investigate how inter-organisational collaborations lead to the creation, sharing and exchange of knowledge with potential

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benefits for the companies involved, especially in terms of innovation. To achieve this, we observed the circular economy context since, as mentioned above, the interactions between different knowledge areas, as well as the interaction between different actors, are considered strategic keys to support and foster the transition to the circular economy.
Furthermore, our paper also aims at contributing to the debate on industrial symbiosis and innovation processes in circular enterprises, focusing on knowledge management (KM), through the integration of different skills provided by local partners. The results underline that the collaborations with local actors are a phenomenon rooted in circular businesses, and that the interconnections between different and complementary knowledge and skills are fundamental to support circular innovation. Implications and suggestions for future studies derive about the knowledge management function both in managing knowledge flows to and from partners and in processing knowledge.

Keywords – Circular economy; Inter-organisational collaboration; Industrial symbiosis; Knowledge Management

Paper type – Academic Research Paper

1 Introduction

Interactions between different knowledge areas and inter-organisational collaboration are considered the strategic keys to support the transition to the circular economy (Bengtsson et al., 2015; Greco et al., 2019; Bagherzadeh et al., 2021). In fact, interdisciplinarity can be a driver capable of increasing the value of the outputs of innovation processes (Savino et al., 2017).

The circular economy is receiving increasing attention, as it has the potential to move away from unsustainable production and consumption patterns, such as the linear one (Kristensen and Mosgaard, 2020). It is able to reduce the environmental impact, contributing to the ecological transition, while generating economic benefits and meeting social needs, in order to preserve the future generations (Buil et al., 2017). CE is a model that embraces the three dimensions of sustainability, namely the economic sustainability, the environmental sustainability and the social sustainability (Murray et al., 2017) and is aligned to the Sustainable Development Goals (Preston and Lehne, 2017).

The circular economy also plays a very important role for the competitiveness of companies that, through the so-called 4R/9R practices (Kirchherr et al., 2017), can improve the efficiency and effectiveness of their activities, creating new value (Velenturf et al., 2019; Mignacca and Locatelli, 2021). This requires strong and proactive relationships with an extensive network of stakeholders (Bocken and

Ritala, 2022). In this direction, the industrial symbiosis approach recalls the strategic importance of the complex interaction of a network of stakeholders, each with specific and individual identities, to contribute to the co-creation of an ecosystem of shared value (Pera et al., 2016). This approach is based on the involvement of firms located within the same geographical area which become part of a collective approach to competitive advantage involving the physical exchange of materials, energy, water and/or by-products (Chertow, 2000).

Starting from the above premises, our study aims to investigate how inter-organisational collaborations lead to the creation, sharing and exchange of knowledge with potential benefits for the companies involved, especially in terms of innovation. To achieve this, we observed the circular economy context since, as mentioned above, the interactions between different knowledge areas, as well as the interaction between different actors, are considered strategic keys to support and foster the transition to the circular economy.

Furthermore, our paper also aims at contributing to the debate on industrial symbiosis and innovation processes in circular enterprises, focusing on knowledge management (KM), through the integration of different skills provided by local partners. In line with this, the study considers the following research question (RQ):

> *Does the management of complementary knowledge and skills from local partnerships fuel business process innovation and foster product innovation in circular businesses?*

We performed an empirical analysis on 117 circular businesses located in the Northern Italy, listed in the Italian Atlas of the Circular Economy, in order to observe their approach and inclination to interact with different actors to produce knowledge and innovation.

The paper has the following structure. Section 2 presents the literature review on the theoretical strands of the circular economy, with a focus on the inter-organisational collaborations, industrial symbiosis and innovation; section 3 illustrates the methods; section 4 describes the results emerging from the empirical analysis; section 5 illustrates discussions, implications and conclusions.

2 Literature review

2.1 Inter-organisational collaboration and knowledge management

The inter-organisational collaboration - defined as "enduring transactions, flows, and linkages that occur among or between an organisation and one or more organisations in its environment" (Oliver, 1990, 241) - and the resulting exchange of knowledge are considered prerequisites for the creation of new knowledge (Lee and Choi, 2003). It is able to act on the acquisition of organisational skills, through the transfer or sharing of resources (strategic effects) and on increasing the degree of influence on other organisations (political effects) (Hardy et al., 2003). For example, Ngai et al. (2008) show that in the development of a complex innovation, usually based on the integration of different knowledge flows, the cooperation among different categories of actors is needed. It emerges that collaboration and KM within the network is potentially decisive for a successful performance. Pöyhönen and Smedlund (2004) describe three modes of knowledge creation in inter-organisational collaborations based on the network type: (1) the vertical production network, whose flows of money and physical products are the main element, the exchange of information on production enables the dissemination of knowledge; (2) the development network whose actors, while not cooperating in production, exchange knowledge in order to improve themselves and achieve high levels of efficiency; (3) the innovation network, in which the main objective is the creation of new knowledge, seeking solutions to defined problems.

The development of innovation is one of the main objectives of knowledge management (Ben Arfi and Hikkerova, 2021). Indeed, KM practices within a company enable the generation of innovation, through the maximisation of benefits from tacit knowledge and the implementation of collaborative processes (Jones and Mahon, 2012). In this regard, Du Plessis (2007) state that collaboration implements the collection of tacit knowledge, useful for companies to control costs and risks related to innovation (Ashok et al., 2016).

At the same time, KM assumes a crucial role within the relationships, managing information and knowledge flows exchange, through effective coordination and collaboration processes (Gloet and Samson, 2019). Cai et al. (2013) argue that KM is able to improve knowledge sharing, particularly when a feeling of trust is present in relationships.

Within collaborative processes new ideas are generated and the function of KM is to add further value through the development of knowledge and the implementation of good communication between partners (Gloet and Samson, 2019). As concerns this aspect, an interesting contribution is the one provided by Hoegl and Schulze (2005), who provided a description of the main and most useful on knowledge management tools and methods: informal events, experience workshops, communities of practice, project briefings, expert interviews, best practice cases, knowledge broker, experience reports, databases and research services. These methods support the creation of new knowledge in new product development and differ from the four knowledge dimensions (forming the "SECI" acronym): Socialization, Externalization, Combination, and Internalization (Nonaka, 1994).

Knowledge-Based Inter-Organizational Collaborations (KBIOCs) must respond to four factors (Cricelli and Grimaldi, 2010): knowledge application velocity; degree of complementariness of knowledge; participated mission of the KBIOC and coordination degree of the KBIOC. Further aspects such as trust, long-term orientation and commitment are considered fundamental to the free flow of knowledge within collaborative relationships (Mavondo and Rodrigo, 2001). Indeed, in 1994 Morgan and Hunt with commitment-trust theory argued for the centrality of trust and commitment within a network of enterprises, rather than power, assuming a positive relationship between trust and cooperation. Therefore, inter-organisational collaboration seems a necessary element in highly innovative contexts, such as the circular economy, where the need for innovation often encounters capacity and infrastructure problems (Den Hollander, 2018).

2.2 Inter-organisational collaboration in circular business models

The adoption of circular business models introduces a number of changes in the operating practices of companies, which favour a more responsible use of resources and materials in order to substantially reduce the negative impact on the environment and societies (Luthra et al., 2022). Collaborative practices and the exchange of resources among different industries, with the aim of reusing and recycling by-products to achieve zero waste, underpin the circular economy model (Branca et al., 2020). Recent studies have shown that collaboration with stakeholder groups, suppliers, research institutions and other companies, is an enabling factor for the implementation of circular practices (Eisenreich et al.,

2021). It underpins the creation of new knowledge, which can generate radical innovations, identify new business opportunities and meet the challenges of the CE (Potting et al., 2017; Hettiarachchi et al., 2022).

The CE can be considered an "umbrella" concept based on several principles (Baldassarre et al., 2019): waste design, building resilience through diversity, using renewable energy and converting waste into a new resource for reuse (MacArthur, 2013). In this perspective, the academic debate has brought the concept of industrial symbiosis closer to the circular economy (Kanda et al., 2021).

Industrial symbiosis is based on the identification of symbiotic opportunities between different sectors where geographically close companies can exploit synergistic exchanges with great success (Chertow, 2007) and find innovative ways to source inputs and optimise the value of the residues of their processes (Domenech et al., 2019). This approach has been placed at the centre of strategies to promote the transition to the circular economy (Domenech et al., 2019), since it is able to bring together several companies, apparently distant, to achieve shared goals and find better solutions in a circularity perspective, in which products, by-products and waste circulate between different industries (Batista et al., 2018; Tseng et al., 2020). This approach requires a technical effort based on the exchange of waste, resources and energy (Chertow, 2007), and collaborative effort (Baldassarre et al., 2019) in which stakeholders seek together successful solutions around the elimination of the concept of waste in relation to the supply of virgin materials and energy (Bocken et al., 2014). The improvement of resource efficiency and the implementation of industrial symbiosis partnerships are considered key success factors for the company aiming at developing new sustainable products and processes (Castiglione et al., 2021).

Business innovations dictated by circular economy practices can affect the organisational structure of the company, generating changes within the company structure or production chain (for example, identifying new supply chains and new partners with whom work), and generating process and product innovation (Castiglione et al., 2021; Engez et al., 2021). Process innovation requires the adoption of new production methods and the use of technologies that facilitate environmental and social performance (Pichlak and Szromek, 2022), while product innovation is based on the creation of sustainable, easily disposable and recyclable products (Castiglione et al., 2021).

KM acquires a more strategic relevance in circular enterprises, as it must support the sharing of information both inside and outside the company,

contributing to the construction of networks of interactions capable of positively affecting the creation of innovative process and product practices (Geissdoerfer et al., 2017; Brown et al., 2021), thanks to di adoption of methods and tools as teleconference, video conference, whiteboards and chat rooms, e-mail, forum, groupware calendar, shared information spaces workflow management system, group decision support system and active participation in meetings (Ghani, 2009; Massingham, 2014).

Capturing new knowledge for new highly sustainable products, services and technologies becomes a crucial aspect (Gloet and Samson, 2019), as well as the role played by KM in managing knowledge flows among partners and in processing knowledge to produce organisational, process and product innovation (see figure 1).

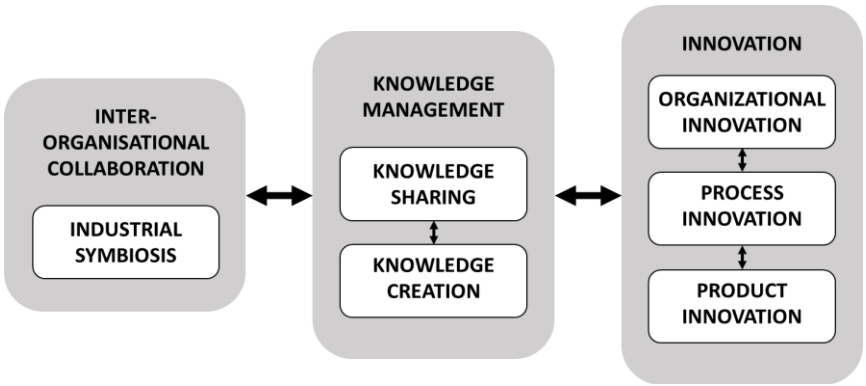

Figure 1 Theoretical framework

3 Methodology

Starting from the proposed theoretical framework (figure 1), the empirical research aims to explain KM, within collaborative practices, and how it supports innovation in circular businesses.

The analysis was carried on in two phases. First, we detected information provided by a sample of 117 circular companies of Northern Italy, since this area represents one of the areas with a greater number of companies implementing circular economy practices. Data were extracted from the companies' documents, available on the web platform (www.economiacircolare.com) and on the companies' official websites; data collection lasted 7 months (from May 2022 to November 2022).

With special reference to the industrial symbiosis, we focused on the presence of actors operating on the same territory with whom the circular practices have been developed; the type of partners and the degree of complementariness of knowledge; the benefits obtained. All these aspects have been analysed in relation to the company profiles. Survey items are illustrated in figure 2.

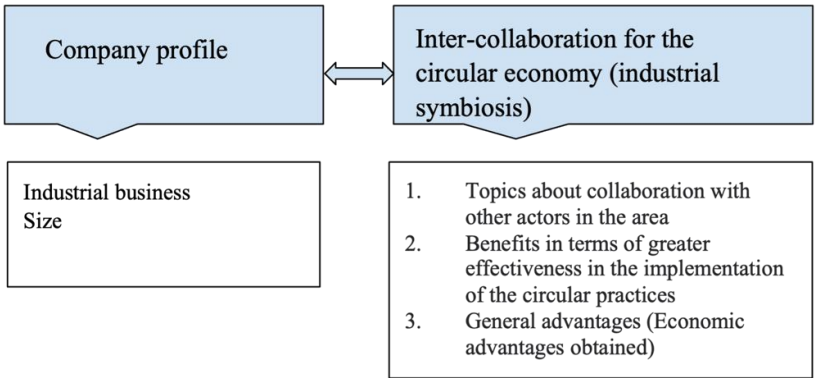

Figure 2 Survey items

In the second phase, we focused on the innovation initiatives implemented by the companies analysed. Only 86 firms have been taken into account in this second phase of the analysis, namely those that declared to collaborate "with local operators". In addition, we also paid attention to the practices of KM and knowledge sharing. To carry on the second phase of the research process, we performed a content analysis on the documents collected. The table 1 summarises the main characteristics of the dataset. In particular, we selected documents in the same language (Italian) and with a similar length.

The analysis was performed through the software NVivo (Krippendorff, 2012), since it is considered as one of the most suitable tools when carrying on this kind of investigation (Harwood and Garry, 2003; Houghton et al., 2015). In fact, the software gives the opportunity to perform different levels of analysis and to combine results to classify the information obtained and observe linkages among them.

Table 1 Detail of content analysis

Company documents	86
Average length	800 words
Language	Italian
Tool	NVivo
Main topics	Innovation and KM

4 Results

More than half of the circular companies analysed (74%) declared to collaborate with external actors from the surrounding area (figure 3). Of these, 25% declared collaborations with companies in the same industrial sector (namely with actors with the same basic skills); 22% declared to cooperate with research institutions and universities and the same percentage with other companies (from different industrial sector). Smaller percentages are found in collaborations with "other types of actors" 16% and 15% with the combination of several territorial actors included in the previous options (figure 4). This first results highlight the relevance of interconnections between actors with different and complementary skills when dealing with CE initiatives.

Furthermore, it is interesting to observe that most of companies (70%) declared that the inter-organisational collaboration was also due previous relationships with actors located in the surrounding area.

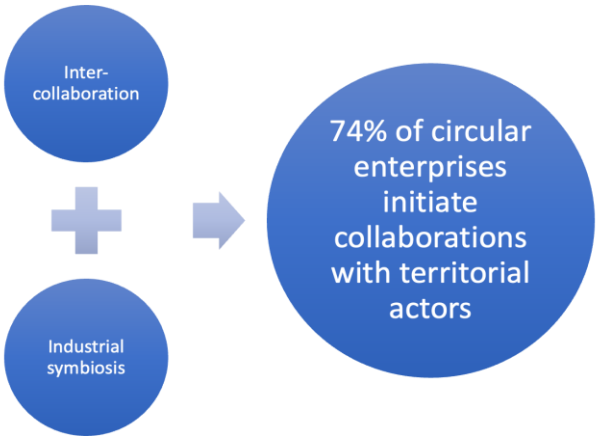

Figure 3 Industrial symbiosis in circular companies

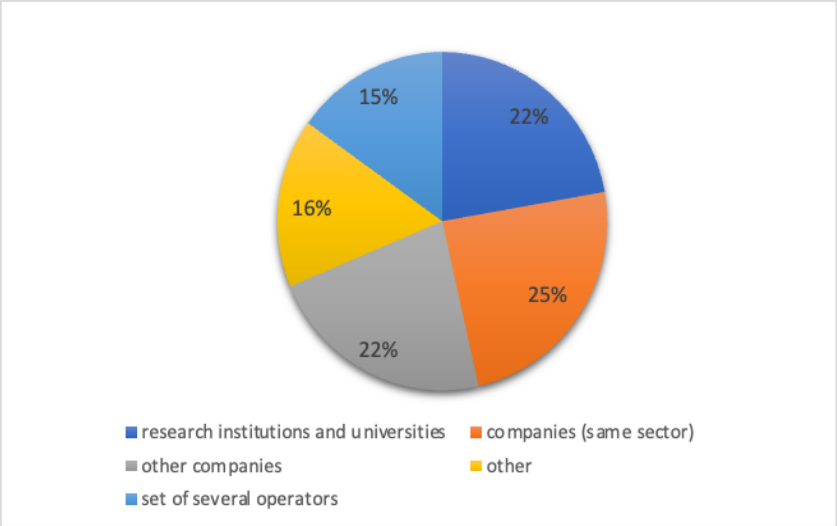

Figure 4 Degree of complementariness of knowledge

Another element emerging from the analysis concerns the benefits declared by companies through the cooperation with external actors (Figure 5). 78% of companies collaborating with external partners declared to have obtained benefits. In particular, 52% of companies declared to have achieved benefits in relation to greater effectiveness in the implementation of the circular practices.

However, the majority of companies does not consider the economic benefits as the main goal when establishing collaborations with external actors: in fact, 55% of companies don't mention economic benefits. This is even more interesting of we consider that many of analysed companies are start-ups, born so recently, that they are probably not yet able to illustrate the economic benefits generated by collaborations and circular economy initiatives.

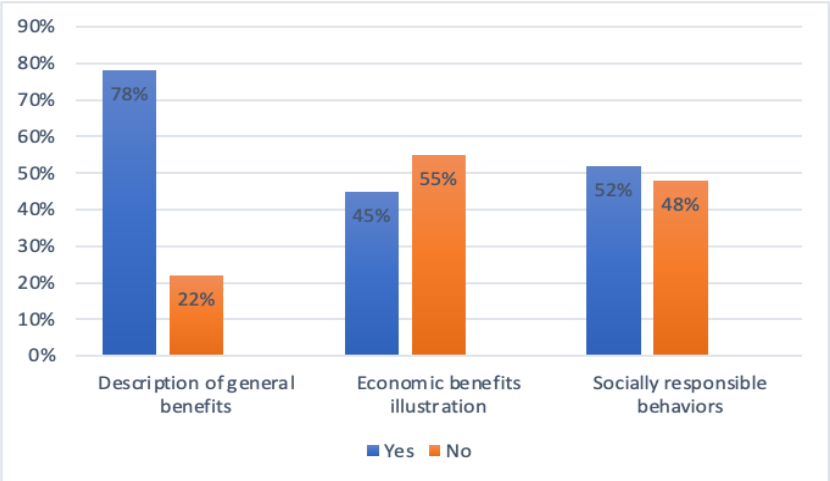

Figure 5 Benefits declared

The results of the content analysis highlight a link between inter-organizational collaboration and circular innovation. First, we detected the most frequently mentioned words (word frequency), in the range of 0.47%-0.10%, with a strong positive connotation and relative frequency of occurrence; the word frequency let us to identify the most mentioned aspects (table 2). It is evident that the content of these words that emerged from the word frequency is mainly of a rational and organizational nature, such as the words politics, products, sustainability, production, services, process and collaboration.

Table 2 Results Word Frequency

Word	**Frequency**
policies	197
products	179
sustainability	174
production	137
circular	101
services	87
territory	84

reuse	77
process	53
collaboration	43

In order to verify the way each aspect is discussed and taken into account by companies, in the following table we provide a list of quotes (Table 3), that highlights the relevance of the innovation phenomenon within the company documents. In this case, the direct link between innovation and collaboration does not emerge, but it is possible to identify the type of innovation developed by companies. However, it is possible to assume an indirect link, since the content analysis only considered the documents of companies that collaboratively develop circularity practices, although it is believed that this aspect should be further investigated through an analysis of primary data.

In particular, the results of the content analysis highlight the strong innovative capacity recognised by the companies as recipients of various awards; the strategic nature attributed by them to innovation; the importance of the sustainable nature of innovation; the market innovation these companies generate by introducing circular products. Significant elements about KM and knowledge sharing practices don't emerge, although knowledge and knowledge sharing emerge as very relevant phenomena in the literature.

Table 3 Results Text Research

Circular companies	**Quotes**
Equilibrium (0.75% Coverage)	Environmentally Friendly Innovation Award in 2013; working and investing in innovation, research and development
Ecobnb (0.67% Coverage)	example of tourism business innovation; 1st runner up in the category Business Innovation 2017
Eurven (0.58% Coverage)	continuous applied research/innovation
Laboratorio Rise (0.53% Coverage)	leads 12 corporate innovation projects; The main innovation themes addressed include Circular Economy
Krill Design (0.42% Coverage)	Mix of circular economy, innovation and creativity

Relight (0.41% Coverage)	The organisation aims to achieve objectives of innovation and social responsibility; the dynamism of the innovation process of the equipment placed on the market; policy aimed at the process of innovation in technology; National Award for Environmentally Friendly Innovation, promoted by Legambiente
Coworking Milano (0.30% Coverage)	coherence, sustainability and innovation for more efficient mobility; social inclusion, environmental quality, innovation and economic efficiency
SostInnoVi (0.26% Coverage)	Sustainability and Innovation in the Wine Supply Chain
Izmade (0.22% Coverage)	Centre for Art, Innovation and Research dedicated to design
Sumus (0.21% Coverage)	a driver of innovation and a stimulus for improvement

5 Discussion, implications and conclusions

Some strong links among the investigated phenomena can be deduced from the research: (1) collaborations with local actors are widespread in circular businesses and are also prompted by the strong interest in the territory. Actors showing a high inclination and propensity to implement CE initiatives also show a strong connection and link to the territory and in their willing to cooperate with local actors and select nearby partners; (2) the industrial symbiosis connects complementary knowledge flows, allowing to obtain advantages with a strong strategic value since they concern the circular practices themselves. In other words, it can be deduced that, without collaborations, the circular companies cannot be created; (3) circular companies have a strong innovative capacity, that can be detected by the declaration of the achievement of various awards, often leading to the creation of new products, concretely contributing to sustainable development.

These findings are in line with previous studies on the strategic value of collaborations in circular economy practices (Cricelli et al., 2021) and on the value of synergistic exchange between actors from the same territory in supporting innovation (Domenech et al., 2019). With regard to the achievable advantages, the literature also underlines the strategic value of collaborations on a territorial scale for the purpose of improving the competitiveness of companies due to the

reduction of the cost of waste disposal, as well as for the costs of procurement of virgin materials (Bocken et al., 2014). This aspect is not sufficiently supported by the results, just as the role of KM and how companies manage knowledge within the collaborations for the development of product, process and organisational innovation does not emerge from the analysis of the secondary data. This brings out the need to conduct further analyses on primary data to better investigate some aspects of the relationship between inter-collaboration, KM and innovation that currently we can only deduce, as they are not directly mentioned by companies.

Further research topics are:

1. the importance of merely intangible aspects in the creation, sharing and management of knowledge. Literature recalls that long-term shared objectives and a relationship based on mutual trust as well as on shared corporate values are fundamental to build profitable collaborative relationships between firms (Mavondo and Rodrigo, 2001), and for there to be a sharing and creation of knowledge that can represent a benefit both for the actors directly involved, and for the other actors of the territory that are not directly involved;
2. the importance of KM in managing and coordinating the exchange of information and knowledge between partners. The theoretical debate underlines that services and technologies are crucial factors (Gloet and Samson, 2019) for the KM, both in managing knowledge flows to and from partners and in processing knowledge. Hence, further aspects to be explored also concern the practical tools used by companies (for example, teleconference, video conference, whiteboards and chat rooms, e-mail, forum, groupware calendar, shared information spaces workflow management system, group decision support system and active participation in meetings) (Ghani, 2009; Massingham, 2014).

In line with the strong linkages that emerged from the analysis, the main implications of this study are above all of an institutional nature; in particular, the role of policies in nurturing the encounter between actors within the same territory emerge as highly relevant, especially in supporting the exchange between complementary knowledge and in stimulating the development of specific skills within territories; these can be useful to the exchange, in a symbiotic approach, among the local actors for the green transition of territories, as well as

promoting the autonomy of local economies, reducing the so-called external resource dependence.

In addition, important managerial implications can also be detected with reference to the relevance of collaboration among local actors, although future research developments on the topics identified are needed.

To this end, future studies will focus on the intangible aspects that affect the creation, sharing and management of knowledge, but whose entity has made their recognition through secondary data complex; therefore, this research will be deepened through semi-structured interviews to key-informants, that are already identified in the previous phase of analysis. In detail, the main aspects the interviews will focus on are: the direct or indirect link between collaborations among local actors and innovation; the direct or indirect link between collaborations among local actors and innovation developed through CE initiatives; how market dynamics are affected by the collaborations among local actors.

In conclusion, our study offers a double contribution: (1) the provided framework will be adopted to advance the present study involving key informants through semi-structured interviews to offer managerial implications and recommendations; (2) the framework represents a contribution to the theoretical debate that can be applied to different research contexts.

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Investigating Circular Business Implementation's Antecedents: An Empirical Assessment of Open Innovation and Digital Technologies Adoption

Francesco Antonio Perotti*

Department of Management, University of Agder
Universitetsveien 25,
4630 Kristiansand, Norway
Department of Management, University of Turin
Corso Unione Sovietica, 218/bis,
10134 Torino, Italy

Ciro Troise

Department of Management, University of Turin
Corso Unione Sovietica, 218/bis
10134 Torino, Italy

Alberto Ferraris

Department of Management, University of Turin
Corso Unione Sovietica, 218/bis
10134 Torino, Italy

* *Corresponding author*

Abstract

More and more companies are winking at sustainability through the adoption of circular business models, which are based on resource and waste minimization to establish a renewable closed-loop production and consumption system. Departing from a linear take-make-use-dispose setting, circular economy principles lead businesses' transition toward the development of circular products and processes. Drawing on past studies that associate circular businesses with the adoption of digital technologies or open innovation approaches, this research seeks to shed light on the role of openness in companies' innovation approach and digital technologies in fostering a circular business model development. In this vein, the authors' purpose is to quantitatively evaluate such elements as predictors of circular business model development and thriving. After pointing out some key features of the research, the paper concludes with the presentation of the expected

findings and the discussion of the potential theoretical and practical implications of the study.

Keywords – Circular Economy, Open Innovation, Digital Technologies, Dynamic Capabilities, Resource Orchestration

Paper type – Academic Research Paper

1 Introduction

In recent years, circular economy (CE) has prompted considerable debate among researchers and practitioners about the fundamental role of economic organizations in driving environmental preservation and social well-being. More and more companies are indeed gradually translating their sustainable purposes into business practices by giving rise to circular business models (CBMs), yet the harsh reality proves that it is not enough (Aranda-Usón et al., 2020; Bocken et al., 2016; Geissdoerfer et al., 2020; Ranta et al., 2018). In spite of the visible effort of policymakers, academics and managers, the world is currently less than 9% circular, while it is supposed to at least double by 2032 to avoid climate breakdown (Circle Economy, 2022; European Commission, 2020a; Pizzi et al., 2020; United Nations, 2021). This testifies how companies around the world are taking their first steps towards a regenerative production system but, most importantly, it demonstrates that there is still a long and impervious road ahead. Countless challenges and opportunities stand in front of academia and businesses, including the chance to boost this sustainable shift by adopting collaborative innovations or surfing the wave of digital transformation.

Drawing on previous studies (e.g. Brown et al., 2019; De Angelis et al., 2023; Hina et al., 2022), two common drivers that can potentially affect the transition toward a circular economy by fostering companies' adoption of circular principles are represented by open innovation strategies and digital technologies adoption. Open strategies, which involve cross-boundary companies' interaction to develop circular innovations, showed to be strictly related to the transition toward a renewable production system (Brown et al., 2021; Jesus & Jugend, 2023; Köhler et al., 2022). On the other hand, digital technologies have the potential to significantly enhance circular business development by leveraging resource optimization, the orchestration of closed-loop systems, circular product design, collaboration, and waste management (Hina et al., 2022; Khan et al., 2021b; Liu et

al., 2022). Open innovation strategies and digital technologies adoption, together, have also the potential to support co-innovation processes of circular businesses (Bresciani et al., 2021; Mubarak et al., 2021; Santoro et al., 2018; Walker et al., 2023). As a result, the purpose of this article is to unveil how an open innovation approach and digital technologies adoption foster circular economy implementation. Besides, the authors also considered how key dynamic and recourse orchestration capabilities can support open innovation processes and companies' digital transformation in approaching a circular transition.

The main gap this research aims to fill is related to testing the predictor effect of those antecedents, by offering new insights based on a quantitative observation. Indeed, from researchers and practitioners' perspectives, a quantitative investigation of this phenomenon in circular businesses is highly demanded.

2 Theoretical background

The burgeoning literature devoted to the circular economy often deals with factors that can improve this kind of sustainable practices in economic organizations. It includes the openness of companies to collaborate with other entities to develop circular products and processes, as well as the adoption of digital technologies to enable and enhance circular businesses.

Drawing from CE literature, academics have put forward that inter-organisational collaboration is a key success factor to develop circular-oriented innovation. In fact, Brown et al. (2019, p3) define circular-oriented innovations "as the coordinated activities that integrate CE goals, principles, and recovery strategies into technical and market-based innovations, such that the circular products and services that are brought to market purposively maintain product integrity and value capture potential across the full life-cycle". While circular-oriented innovation is a novel and little-understood concept, we can identify, in collaborative innovation literature, some antecedents to the adoption of such innovation models. In fact, literature shows that the primary motive for exploring strategic collaborative innovation is the increase of knowledge flows (Appleyard & Chesbrough, 2017). Other reasons that push companies to adopt such models are the increased competitiveness and the market share of innovations, the access to resources or to new markets or the acquisition of new skills (Brown et al., 2019; Bocken & Ritala, 2021). However, circular-oriented innovation exposes the firm to

the opportunistic behaviours of the partners involved in the process (Pouwels & Koster, 2017). Potential partners involved in circular-oriented innovation must be aligned in terms of vision and sustainability policies to overcome the possibility of reputation pitfalls. A practical example of companies' alignment can be found in those that approach circular economy through reverse logistic processes (Cricelli et al., 2021; Mishra et al., 2021). However, despite open innovation strategies adopted by circular businesses have been addressed in previous studies, to the best of the authors' knowledge a measurement of its impact on circular business implementation is still missing.

On the other hand, literature highlighted as digital transformation has a critical role in supporting business sustainability and, more specifically, circularity (Biondi et al., 2002; Hina et al., 2022; Khan et al., 2021b; Kristoffersen et al., 2020; Liu et al., 2022). It has proved to be crucial for transitioning from a linear to a more circular production, with demonstrably positive impacts on both the environment and the economy (European Commission, 2021; Pizzi et al., 2021; Ranta et al., 2021). In practice, digital technologies (e.g., IoT, big data, blockchain, virtual reality, AI and machine learning) can support companies' businesses' circular transition path by transforming CE principles into feasible and practical activities (Chauhan et al., 2022; Ciliberto et al., 2021; Kerin & Pham, 2019; Rajput & Singh, 2022; Rusch et al., 2022). Yet, scant research deals with digital technologies adoption as a predictor element of circular economy implementation from an empirical point of view.

As the conversion, or establishment, of circular practices represent a disruptive change in production and consumption models, as well as in innovation processes, this process is typically addressed in circumscribed agile environments or ambidextrous formations (Bresciani et al., 2018; Chaudhuri et al., 2022; Rialti et al., 2019). From a transitional perspective, the implementation of a circular business may require some dynamic capabilities for companies, in terms of sensing and seizing opportunities, so as to reconfigure the business model according to a renewable production system (Eisenhardt & Martin, 2000; Khan et al., 2021a; Teece, 2014). On the other hand, resource orchestration capabilities concern the optimization of resource management by companies to achieve a competitive advantage (Kristoffersen et al., 2021; Teece, 2014; Gong et al., 2018). Resource orchestration seems to be essential in solving internal conflict and improving resource complementarities in organizations, while supporting the dynamic capabilities needed in facilitating circular innovation (Wang et al., 2020;

Wales et al., 2013; Walker et al., 2023). They can thus represent an incentive that improves open innovation and digital technologies adoption as circular economy implementation antecedents.

3 Research design

As a quantitative deductive study, it is established on the empirical observation of European for-profit organizations that implemented, or are integrating, circular economy principles in their businesses. The authors adopt a non-probability sampling to gather data from a subset of the population of circular companies in Europe to investigate the role of an open approach and the adoption of digital technologies alongside the circular product or process development. The independent and dependent variables of our cross-sectional study (i.e. open innovation, digital technologies adoption, and circular economy implementation) are measured employing items assessed in previous studies (e.g. Khan et al., 2021; Mina et al., 2014; Mubarak et al., 2021), by means of a five-point Likert scales that range from "Totally disagree" to "Totally agree". This empirical study will be based on at least 300 valid responses collected by online surveys delivered through the Prolific online platform (e.g. Talwar et al., 2021). Data validity and reliability will be assessed through confirmatory factor analysis (CFA), to then test our assertion by means of a covariance-based structural equation modelling (CB-SEM) technique.

4 Expected findings and research implications

As such, this study aims to observe if intra-organizational collaboration, in the form of resource exchange in an open innovation setting, and companies' digital technologies implementation can effectively affect circular business establishment. Authors expect to outline a significant positive relationship between our independent (i.e., open innovation and digital technologies implementation) and dependent (i.e., circular economy implementation) variables, alongside a significant positive moderating effect of dynamic and resource orchestration capabilities (see Figure 1). Thus, this study will contribute to circular economy literature as the first empirical-based quantitative study to prove the advanced relationships on a representative sample of European circular businesses.

Both open innovation and digital transformation need to be further studied in circular businesses due to their important implications on processes such as

reverse logistics. Indeed, business digitalisation has been noted to be a backing element in configuring reverse logistics processes for collecting waste and raw materials, so secondary resources can be transformed into new products or service supplies through the implementation of a circular ecosystem for granting a renewable production and consumption system (Ciliberto et al., 2021; Rajput & Singh, 2022). In this vein, also intra-organizational collaborations and open innovation strategies concur to shape business transition toward a circular model enabling circular product and process development (Cricelli et al., 2021; Mishra et al., 2021).

From that perspective, the authors will be able to offer some insightful contributions to the circular economy literature (), as well as respect to open innovation studies (Appleyard & Chesbrough, 2017; Bocken & Ritala, 2021) and the literature stream that deals with digital transformation in business realities (). This study will also offer some practical implications to circular businesses in the form of recommended practices which can support circular transition in sustainable-sensitive businesses.

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Food Supply Chain and Covid-19: Immediate Impact and Post-Pandemic Strategies

Eleonora Bottani*

Department of Engineering and Architecture
Viale delle Scienze 181/A
43124 Parma, Italy

Barbara Bigliardi

Department of Engineering and Architecture
Viale delle Scienze 181/A
43124 Parma, Italy

Benedetta Pini

Department of Engineering and Architecture
Viale delle Scienze 181/A
43124 Parma, Italy

Marta Rinaldi

Department of Engineering
University of Campania "Luigi Vanvitelli"
via Roma 29, 81031, Aversa, Italy

** Corresponding author*

Abstract

The food sector has been one of the industry fields most severely affected by the Covid-19 pandemics. The food industry, indeed, manufactures essential items, and as such, it is expected to continue supplying goods, despite the (even exceptional) external disruptions. This is why at the beginning of the pandemic period, there has been a great deal of worry regarding food production, processing, distribution, as well as significant changes in the demand for finished products, with various observed phenomena. The Covid-19 pandemic also had a negative impact on the food supply chain from a financial point of view, because of restrictions in labour, unavailability of suppliers and difficulties in quickly finding alternative vendors.

This paper aims at summarizing the key issues experienced by the food supply chains during the Covid-19 pandemic and then at delineating appropriate strategies for building more resilient chains in the post-pandemic period. To achieve this stated aim, the chosen

research methodology is the systematic review of the literature, as the food industry was one of the most investigated systems in the pandemic and post-pandemic era. Results are expected to categories the available knowledge about the role of Covid-19 on food supply chains, as well as to provide some useful guidelines for managing food supply chain in the future.

Keywords – Covid-19, food supply chain, resilience, literature review, post-pandemic strategies.

Paper type – Academic Research Paper

1 Introduction

The Covid-19 pandemic has disrupted social and economic life worldwide (Kwon, 2020). Still in 2023, it leaves its shortcoming and even if we are entering a post-Covid era, cannot be described as completely over. Hence, how to look at the way of life has changed in many contexts, and new solutions and approaches have been defined either as immediate countermeasures to the Covid-19 pandemics or as permanent measures to better cope with (not only) exceptional disturbances in the future (Bottani et al., 2022; Telukdarie et al., 2020).

The food sector has been one of the industry fields most severely affected by the Covid-19 pandemics. Food supply chains (FSCs) are networks of companies often spread worldwide, that collaborate for procuring raw materials (from the agricultural field), manufacturing a food product, delivering it to the customer and sometimes managing returned goods. As such, a FCS typically consists of five stages, such as agricultural production, postharvest handling, processing, distribution/retailing, and consumption.

During the pandemic period, there has been a great deal of worry regarding food production, processing, distribution, as well as significant changes in the demand for finished products, with various trends. Looking at the *processing* stage, the food industry manufactures essential items, and as such, it is expected to continue supplying goods, despite the (even exceptional) external disruptions, which could cause the unavailability of raw materials or intermediate goods (*agricultural production* and *post-harvest* stages). Restrictions in labour, unavailability of suppliers and difficulties in quickly finding alternative vendors (Montenegro & Young, 2020) are among the reasons why the procurement chain could have been interrupted by the Covid-19 pandemics. Researchers have therefore analyzed the quality of the service level during the pandemic in

distribution/retailing activities, by evaluating the rate of cancelled orders (Zhang et al., 2020), unfilled orders (Altig et al., 2020), shipping delays (Gereffi, 2020), and out of stocks (Pantano et al., 2020). At the same time, looking at the *consumption* stage, it is also reasonable to expected that in crisis situations, people tend to buy essential goods (such as food or medical products), while avoiding purchasing non-essential ones (Nader et al., 2022). Accordingly, some authors (e.g., Borsellino, 2020; Loske et al., 2020) have observed that the early lockdown measures have changed the people's purchasing behavior, involving the so-called "panic buying" and causing unexpected peaks of demand for food products; at the same time, however, an opposite trend (i.e., a decrease in demand) was caused by consumers' less frequent store visits and restrictions to movements (Ramakumar, 2020). By the way, Rinaldi et al. (2021) have also found that the impact of Covid-19 on food consumption depends on the type of food category and distribution channel. Overall, early analyses carried out during the first stage of the pandemic have highlighted various aspects, somehow contrasting, related to demand-side shocks and the sudden changes in consumption patterns in FSCs (Hobbs, 2020a). Shafiee et al. (2022) have also noted that a further challenge for food or pharmaceutical products is the perishability of the items handled, which involves additional risks, exacerbated in a pandemic period.

On the basis of the above evidence, some authors (e.g., Aday & Aday, 2020) have delineated a strategic preparedness and response plan including all the measures to guide all the nations to respond to the virus consequences. Also, other authors have investigated the immediate and medium-term strategies for counteracting the pandemic emergency in various contexts, including the FSC (Rinaldi & Bottani, 2022). Because of the progress of the pandemic emergency and the beginning of the "post-Covid-19 era", the time is ripe to conduct an analysis on the immediate and (most importantly) medium-term strategies of food businesses to come out stronger and outstanding for the future (Jagt et al., 2020; Alabi & Ngwenyama, 2023). This is the aim of the present paper, and to achieve that goal, the chosen research methodology is the systematic literature review (SLR), as the FSC was one of the most investigated systems in the pandemic and post-pandemic era.

The remainder of the paper is organized as follows. Section 2 provides an overview of the selected research methodology. Section 3 shows the key results from the SLR and discusses them. Section 4 comments on the implications from this study, the need for future research directions and finally concludes.

2 Methodology

To evaluate the state-of-the-art of pandemic and post-pandemic strategies implemented in the FSC, an SLR was carried out. SLRs aim to search, appraise, synthetize, and analyse all the studies relevant for a specific field of research (Hamja et al., 2019; Palmarini et al., 2018). Moreover, a contextualized analysis of the literature typically helps create or improve our knowledge of 'why, 'in what circumstances' and 'when' certain phenomena can be observed (Durach et al., 2021). This kind of review was selected because it allows to construct and understand specific theoretical concepts, obtain the information needed to construct a set of relevant bibliographical references, analyse the results at a quantitative and qualitative level, as well as suggest future research directions on the subject (Seuring et al., 2005). A typical SLR consists of three steps, i.e., (1) the creation of the sample of papers; (2) the collection of the relevant data; and (3) the analysis of these data (Liao et al., 2017); these steps are illustrated in the subsection that follow.

2.1 Creation of the sample of paper

The sample of papers relevant to this study was obtained by querying the Scopus database (http://www.scopus.com/) in March 2023. The search terms used were quite general in nature, so as to be sufficiently exhaustive in the list of papers retrieved. In particular, the following two queries were combined:

1. "food supply chain" AND "Covid-19";
2. "food supply chain" AND "post-Covid"

The search for the above terms was made in the paper abstract, title and keywords. Results were limited to papers published on journals (with document type "article" or "review") and written in English; no constraints were instead set for the publication timespan. As the terms used are not ambiguous, all the papers resulting from the query were considered as valid and were taken into consideration for inclusion in the sample of documents.

2.2 Data collection

For each of the queries described above, the "export" function of Scopus was used to download the relevant information about the papers. In particular, besides the paper main data (title, authors, publication year, journal title, etc.), the

list of keywords ("author keywords") was also exported in .csv file. The two files were then imported into a Microsoft Excel™ spreadsheet for further processing.

2.3 Data analysis

Some preliminary elaborations were made on the two groups of papers for checking (and removing) the duplicated studies. Statistical analyses were then made on the papers to highlight the trend in time of the publications. Some keyword analyses were also made taking inspiration from the procedure by Fadlalla and Amani (2015). Such procedure suggests analysing the frequency of any keyword (i.e., the number of occurrences in the publication timespan) coupled with its persistence in time (i.e., the number of years since a keyword was used for the first time), for an effective classification of the resulting research topics.

3 Results and discussion

The two queries made on Scopus returned 369 and 29 paper respectively. A preliminary analysis revealed that 28 papers were common across the two queries, while one paper only was specific of the query referring to "post-Covid". This implicitly means that almost all the papers dealing with "post-Covid" strategies also refer to the "Covid-19" period. The sample of unique papers, therefore, consists of 370 studies (Figure 1). The full list of the documents cannot be reproduced in the paper nor in the reference list, because of the page limits, but interested readers are welcome to ask the authors for a copy of the database.

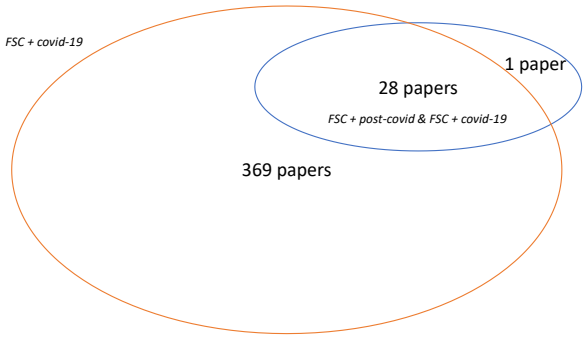

Figure 1: sample of papers.

In terms of the trend in time, the papers retrieved were all published between 2020 and 2023, as it was expected, given the fact that Covid-19 appeared in 2020. Implicitly, this also makes the analysis of the persistence of keywords less important compared to the analysis of their frequency. Looking at Table 1 and Figure 2, it can also be seen that, in general, the number of publications about food supply chains and Covid-related issues has increased in time, growing from 54 in 2020 to >140 in 2021 and 2022 (obviously, results for 2023 are partial). Most of the studies (341 out of 370, >92%) refer to FSC and Covid-19 only, and their trend in time follows the same trend of the whole sample of papers, namely it highlights a significant increase from 2020 to 2022. Similar considerations can be made for the group of papers which are common across the two queries, while the paper dealing with post-Covid aspects only was published in 2022.

Table 1: publication year vs. query.

Publication year	FSC + Covid-19	FSC + post-Covid & FSC + Covid-19	FSC + post-Covid-19	Total
2020	48	6		54
2021	131	11		142
2022	131	10	1	142
2023	31	1		32
Total	**341**	**28**	**1**	**370**

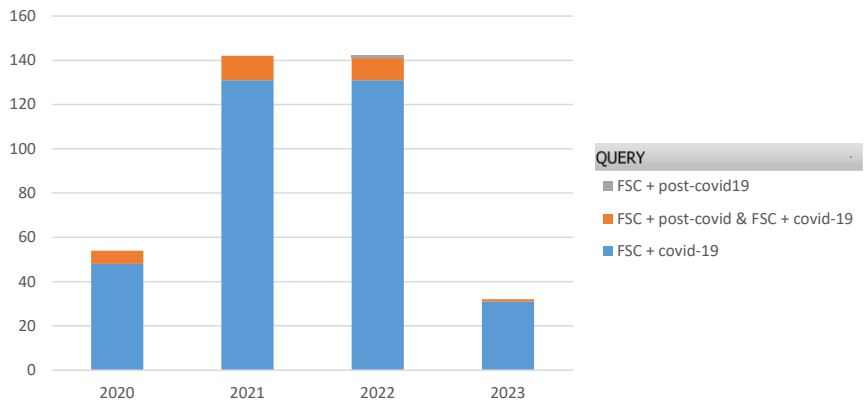

Figure 2: trend of the publications in time.

For these papers, the keywords were then elaborated. In this respect, 25 papers which lack the authors' keywords were omitted in the analysis. A further

preliminary consideration is that the keywords used for the query, and in particular those referring (or related) to Covid-19 and FSC, are obviously expected to have a frequency significantly higher than that of other keywords; hence, they were maintained in the analysis but their reference to the search terms was highlighted, for a correct interpretation of the results. Finally, a manual check of the keywords revealed that authors often use slightly different keywords to express a similar (or the same) concept. This is the case for "Covid"/"Covid-19" or "supply chain"/" supply chains"; hence, keywords were screened and grouped into the same semantic area. This led to a list of 968 unique terms. To be more effective, the analyses of these terms were focused on:

- keywords whose frequency is at least 3, i.e., ≅ 100 terms. This is expected to provide a general overview of the research topics (and related macro-themes) most debated in the literature about FSC, Covid-19 and post-Covid;
- keywords appearing in papers retrieved using the query related to "post-Covid" only. This choice is expected to expressly highlight the strategies suggested in the post-pandemic period;
- keywords appearing in papers published in 2023 (although this set of papers is partial at the time of writing), with the aim to highlight the were recent research topics.

Table 2 displays the list of keywords with frequency ≥3, their relationship with the query made and their classification into macro-themes. Most of the terms, as expected, are somehow related to the queries made, but focusing on terms that are not directly related to the keywords used for the queries, some interesting considerations can be made. A numerous groups of papers deal with the area of *agriculture*, which represent the procurement stage of FSCs, as previously mentioned. This confirms the primary role of this phase in the FSC and at the same time suggests that the attention should be directed towards this stage. A second relevant theme is that of the *consumer*, whose behaviour and purchasing patterns had a relevant role in determining the demand for food products (Chowdhury et al., 2021; Nandi et al., 2020). The impact of the pandemic has in fact led to a different consumption habit of consumers, with fish, chicken, egg, mutton, beef and pork becoming less available or available at a higher price on the market (Aday & Aday, 2020).

Some studies have been conducted in specific *countries*, which is a further interesting aspect, as it suggests that Covid-19 has attracted the attention of

researchers in various countries. Developing countries, in particular, suffered most because of the lack of resources and lack of food for all people.

Decision methods are another branch of research which has become popular in literature; it is to be assumed that specific decision support systems have been developed for dealing with Covid-related issues. *Sustainability* has been addressed in numerous studies as well, in its various facets, from circular economy to sustainable development goals. About *food safety*, in the FSC there is the need for implementing measures for safeguarding food quality, such as primarily, regulations and laws (mandatory) and use of standards (voluntary). Besides the well-known practice of social distances, which is common across various industry fields, in the FSC control measures encompass food staff health, personal hygiene, protective equipment (gloves and helmets), sanitization of work areas and surfaces, as well as safe handling, preparation, and delivery of food.

Finally, *technologies* are related themes (e.g., digitalization, Industry 4.0, etc.) start being investigated in Covid-related studies. The rise of the e-commerce and other electronic channels, which were the only way of reaching the customers in the Covid-19 period, are good examples of digitalization practices; Rinaldi & Bottani (2022) have found that digitalization within the food SC is an ongoing process, which is expected to be accelerated by the pandemic. By the way, technologies could also facilitate social distancing, reduce business travels, and possibly increase food security (e.g., by providing reliable traceability data), and as such, they are welcome in the FSC (Hobbs, 2021a, b).

Table 2: list of keywords with frequency ≥2 and classification.

Keyword	Frequence	Year of appearance	Related to the query	Macro-theme
Covid-19	191	2020	x	Covid-19
Food supply chain	90	2020	x	FSC
food security	65	2020		food safety
sustainability	35	2020		sustainability
resilience	32	2020		resilience
Pandemic	31	2020	x	Covid-19
Covid-19 pandemic	27	2020	x	Covid-19
Food system	26	2020	x	FSC
supply chain	20	2020		supply chain
Food safety	17	2020		food safety

agriculture	17	2020		agriculture
blockchain	17	2020		technologies
Food waste	15	2020		food waste
Agri-food supply chain	14	2020		FSC
short food supply chains	12	2020		FSC
Supply chain resilience	9	2020		resilience
supply chain management	9	2021		supply chain
meat	9	2021		food
Disruptions	9	2021		disruptions
SARS-CoV-2	9	2021		Covid-19
SDGs	8	2021		sustainability
Food insecurity	8	2020		food safety
food supply	8	2020		food production
Food	8	2020		food
China	8	2020		country
Supply chain disruption	7	2021		disruptions
Lockdown	7	2020		countermeasures
Food policy	7	2020		food
food industry	7	2021		food production
Food loss	7	2021		food waste
Internet of things	7	2020		technologies
Perishable food supply chain	7	2020	x	FSC
E-commerce	7	2021		
consumer behavior	7	2020		consumer
Sub-Saharan Africa	6	2020		country
Nutrition	6	2020		
Circular economy	6	2020		sustainability
Sustainable food system	5	2021		sustainability
Urban agriculture	5	2020		agriculture
traceability	5	2020		food safety
Supply chains	5	2020		supply chain
Industry 4.0	5	2021		technology
Bibliometric analysis	5	2021		scientometrics
Agri-Food Sector	5	2021		agriculture
Automation	5	2021		technology
Digitalisation	5	2021		technology
consumer	5	2020		consumer
Simulation	4	2021		methodology

Small and medium-sized enterprises	4	2020		
Food quality	4	2021		food safety
India	4	2021		country
Local food	4	2021		food
Food supply chain management	4	2020		FSC
Malnutrition	4	2020		nutrition
food system resilience	4	2021		resilience
Perishable foods	4	2021		FSC
Aquaculture	4	2021		
Agri-food system	4	2021		agriculture
Case study	4	2020		methodology
dairy	4	2021		food
Food access	4	2021		
sustainable food supply chain	3	2020		sustainability
Small-scale fisheries	3	2021		food
price	3	2021		
short supply chains	3	2021		supply chain
Sustainable development	3	2021		sustainability
post-Covid-19	3	2021	x	post-Covid
poverty	3	2021		sustainability
Supply chain risk	3	2021		
processed foods	3	2021		food production
Safety	3	2021		
vulnerability	3	2021		
Household	3	2020		
Mitigation measures	3	2021		countermeasures
Logistics	3	2020		
health	3	2021		
Livestock	3	2021		
Italy	3	2020		
Local food systems	3	2020		
Kenya	3	2022		country
food price	3	2021		
labor	3	2020		
governance	3	2021		
Literature review	3	2020		
Panic buying	3	2020		consumer

Disaster	3	2022		Covid-19
Epidemic	3	2021		Covid-19
Covid-19 crisis	3	2022	x	Covid-19
Crisis management	3	2020		Covid-19
Agricultural production	3	2020		
Climate change	3	2020		
Agriculture 4.0	3	2021		agriculture
food consumption	3	2021		
Empirical	3	2021		methodology
Agri-food	3	2020		agriculture
Crisis	3	2020		
Digital transformation	3	2021		technology
Decision-making	3	2021		decision methods
diet	3	2020		
food distribution	3	2020		

The papers retrieved using the query related to the "post-Covid" period have returned the keywords listed in Table 3. These keywords all refer to 2022 as the publication year of the paper, and the frequency is in general low. Nonetheless, some of these terms suggest countermeasures to Covid-19; this is for instance the case for "labour mobility" or "regularization", which, coupled with the context of agriculture, could suggest remedies against absenteeism of workers.

Table 3: list of keywords in papers relating to "post-Covid".

Keyword	**Frequence**	**Year of appearance**
Covid-19	2	2022
seasonal migration	1	2022
regularization	1	2022
industrial agriculture	1	2022
social conditionality	1	2022
Labour mobility	1	2022
migrant farmworkers	1	2022

The papers published in 2023 have instead returned the keywords listed in Table 4. All these keywords are single search terms, as can be seen from the frequency; hence, for making the analysis more effective, again a classification

into macro-areas has been carried out. From that classification, it can be seen that *sustainability* is confirmed in its importance even in recent studies, together with other themes related to *risk management* (e.g., *safety/risk management* or *resilience*). It is interesting to note that *sourcing* is a debated topic among recent studies, confirming the relevance of the procurement phase (agriculture) in the FSC. The general role of sourcing decisions in building a resilient supply chain is well-known (see, e.g., Christopher & Peck, 2004), but it is interesting to observe that this strategy is popular in food systems. The role of *decision methods* has also gained importance among recent studies.

Table 4: list of keywords in papers published in 2023 classified into macro-themes.

Macro-theme	**Keyword**
Agriculture	fresh agricultural product; Crop classification; crop-type mapping
Covid-19	long-term pandemic disruptions; Novel pandemic; Emergency; Covid-19 resurgence
Countermeasures	Organizational flexibility
Country	Bangladesh; South America
Decision methods	two-stage sparse distributionally robust risk mixed integer optimization model; random yield; Greenfield analysis; Network optimization; location allocation; Distributionally robust optimization; Chance-constrained programming; Contingency planning; DS-HPSO algorithm; Absorptive capacity theory; deep learning
Food products / FSC	milk consumption; Vegetable supply chain; global food supply chain; food protection; milk sales; Food supply chain performance measures; Food Hubs; milk vendors; nutrition intake; Farmer producer organization; fish consumption; agri-food waste; contaminated cold-chain food and packaging
Resilience	Supply chain reliability; vulnerability assessment
Risk management / safety	Supply chain risk management; safety climate
Sourcing	Supplier relationship; supplier selection; multi-sourcing
Strategy	supply chain integration; Knowledge management;
Sustainability	Sustainable transition; sustainable distribution; sustainable production; social and environmental sustainability; food supply chain sustainability
Other	Vegetable marketing; urban markets; temperature; potential applications; power structure; Sentinel-2; value chain disruption; vehicle routing; presenteeism; pharmaceutical supply chains; worker; Theory of organizational creativity; valorisation; production and operations management; Geopolitical tension; government subsidy; online services; Nexus; Horizon scanning; minerals; informal sector; consumer preference; Direct marketing

4 Implications and conclusions

The Covid-19 pandemic has severely affected the FSC, but, as per any unexpected disturbance, it is paramount to take advantage of the recent emergency for exploiting the acquired experience to convert the Covid-related disruptions into opportunities for improvement.

In this respect, the set of analyses presented above highlight some key strategies implemented in FSCs for counteracting the pandemic emergency or expected to be implemented in the future for building more robust FSCs. First of all, the role of the procurement phase is of certain importance, as it has been highlighted either in the general analysis of keywords (in the macro-theme of *agriculture*) and in the recent studies relating to *sourcing*. This is the obvious consequence of the fact that availability and supply of a wide range of raw materials, intermediate goods, and finished products have been seriously disrupted by the Covid-19 pandemics. It is therefore to be expected that the future of FSCs will see a reinforcement of the procurement stage, for making the systems more reliable.

The role of technologies, in their various forms (e.g., digitalization or Industry 4.0), is also relevant, and is expected to gain further attention in the future, in line with the progressive digitalization of the FSC.

Similar considerations can be made for the food safety area, which has always played an important role in Covid-related literature. Because the need for ensuring food safety and quality will not cease with the Covid-19 end, it is to be expected that the attention paid to these aspects will increase in the future.

The above considerations, in the meanwhile, suggest as many lines of research that could be undertaken in future studies. In particular, research activities for making the FSC more robust should possibly target the sourcing phase, the digitalization of the system and the food safety issues. Evaluating these aspects on a later date could provide evidence of the progress achieved in this respect.

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Unsupervised Learning AI Algorithm-Data Management and Improved Lean Methodology in Healthcare Organizations

Angelo Rosa*

Lum University Giuseppe Degennaro
Strada Statale 100 km 18, 70010 Casamassima BA

Alessandro Massaro

Lum University Giuseppe Degennaro-Lum Enterprise s.r.l.
Strada Statale 100 km 18, 70010 Casamassima BA

Angelo Leogrande

Lum University Giuseppe Degennaro-Lum Enterprise s.r.l.
Strada Statale 100 km 18, 70010 Casamassima BA

Giuliano Marolla

Lum University Giuseppe Degennaro
Strada Statale 100 km 18, 70010 Casamassima BA

** Corresponding author*

Abstract

In the following article, we apply a set of machine learning algorithms to analyse a set of 445 Californian Hospitals. We investigate a variable that can be considered as a synthesis of the economic, financial and organizational performance of the hospital i.e. Net Income. First of all, we have applied a regression analysis with OLS-Ordinary Least Squares to verify the presence of significant relationships among the variables in respect to Net Income. Furthermore, we have applied the k-Means algorithm optimized with the Elbow Method to verify the presence of groups of hospitals in the dataset based on more than 200 variables and centred on Net Income. Finally, we propose a comparison among eight different machine-learning algorithms to estimate the future value of Net Income based on an historical series in the period 2014-2018.
Our idea is that the area of inefficiency that are showed thanks to the regression analysis can be optimized with the application of AI and Lean Management. Specifically, the efficiency of hospitals to manage human resources and specifically physicians can be

improved with the application of telemedicine and organizational tools, that can increase either the performance of the hospital and the level of care offered to patients.
The mix of Artificial Intelligence and Lean Management can promote better models in healthcare, reducing costs, improving the quality of services, increasing the level of human resources especially physicians, to create a more sustainable and reliable healthcare system.

Keywords –Telemedicine, Lean Management, Knowledge Management, A Healthcare, Data Management

1 Introduction

The following abstract shows the application of digitization technique in the context of Lean Management applied in healthcare organizations. Specifically the article provides an innovative methodological approach oriented to describe healthcare complex systems improving organizations in terms of Lean Management by means Artificial Intelligence (AI) algorithms and digital platforms monitoring patients in real time. The efficiency of healthcare organizations is expressed in terms of reduction of costs, optimization of human capital, and ability to design the organizational structure to provide healthcare services to patients.

AI-Data Management processes are enabled by the use of medical devices and sensors (Magaletti, et al., 2021) offering the possibility to acquire a large amount of healthcare data. These data converge in software platforms for remote real time monitoring (Massaro, et al., 2018) thus creating a communication among patients, healthcare professionals, and healthcare organizations. Data are used also for the prediction of the health condition of patients. Healthcare platforms and medical devices are furthermore applied for tele-rehabilitation of patients (Massaro, et al., 2022). Data analysed through the application of AI algorithms generate additional information about comorbidities, and the determinants of diseases (Massaro, et al., 2022), (Massaro, et al., 2022), (Massaro, et al., 2022) allowing to optimize healthcare policies. In Fig. 1 is sketched a simplified model of healthcare organizational model improved by digital monitoring platform and AI algorithms. Covid-19 has increased the level of digitization in medical procedures promoting the application of knowledge management in healthcare organizations through process-based information coordination systems (Elia, et al., 2022). The digital and the AI technology can be used to improve the Lean Management

model typically adopted to increase the efficiency in healthcare organizations (La Forgia, et al., 2022). Healthcare organizations oriented to Lean Management have more probabilities to apply a Value Based Model improving their ability to respond to changes in demand of healthcare services (Rosa, et al., 2020). Digitization is a tool to promote Lean Management even in its connections with value Based Model in healthcare (Marsilio & Rosa, 2020). The combination of Lean Management model and Six Sigma method has positive effect on the ability of healthcare organizations to promote more qualitative services (Marolla, et al., 2021). Furthermore, telemedicine and Lean Management can increase the efficiency of hospital consultation processes as in the case of cardiovascular disease (Bossone, et al., 2022). The application of telemedicine and Lean Management change the relationship between doctors and patients: doctors can visit more patients based not only on geographical proximity, and patients can access more easily to doctors consults overcoming the limits of the distance. Hospitals and healthcare organizations are in a certain sense de-territorialized, and can operate also in distance, through telemedicine. AI-Data Management can also have positive effects on the healthcare system at local level: thanks to the predictive ability, AI-Data Management can forecast the patients' health and the future demand of healthcare services and can help healthcare organizations to change their offer based on the updated socio-economic and demographic conditions of the population. Healthcare organizations can acquire efficiency in the application of a more agile, flat, flexible and data-driven organizations. The combination of AI-Data Management and Lean Management can shape the functioning of healthcare organizations towards the creation of more value added either for healthcare workers either for patients. Finally, the model structured in Fig. 1 allows to optimise different processes about homecare assistance, human resource management, clinical/assistance protocols, and other financial resources management.

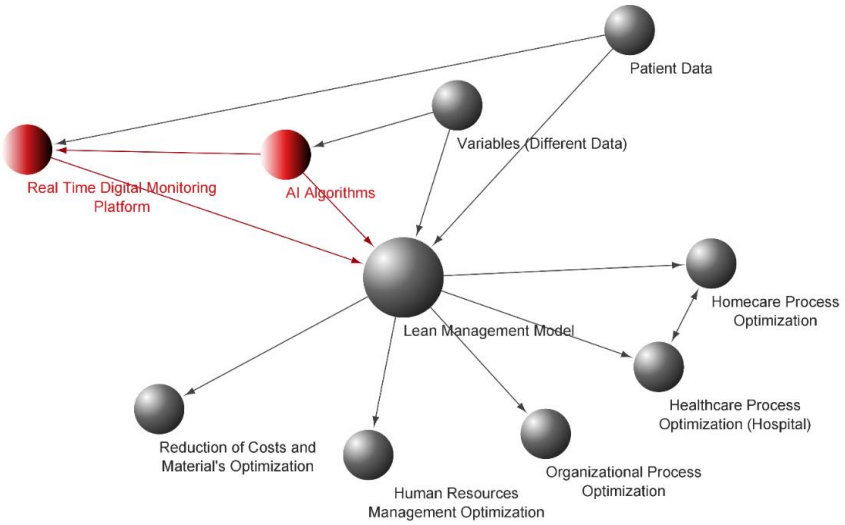

Figure 10. Improvement of the Lean Management model in healthcare processes by AI and telemedicine platforms enabling remote real time monitoring.

The abstract shows the relevance of an interdisciplinary approach in the design of the offer of healthcare services and products improving efficiency through the application of AI-Data Management and through optimised Lean Management procedures. Furthermore, the conjunct application of AI-Data & Lean Management can promote a more efficient orientation towards quality and equity in healthcare organizations (Rosa, 2017).

Linkages between AI and Lean Management. Possible links between AI and Lean Management-LM are mainly due to the prediction of risks and inefficiencies. In particular the main areas of connection are:

- Human Resource Management-HRM optimization;
- whole organization re-engineering;
- movement and allocations of resources according to the new organization model;
- re-arrangement of organization according to a new optimized hierarchical structure;
- change of assignments of human resources according to the predicted risks for patients;
- evaluation of results, and automatic generation of Key Performance Indicators-KPI based on qualitative and quantitative metrics.

These linkages create a common framework for the jointly application of AI and LM.

Data. We will use open data-possibly Kaggle- processed with machine and deep learning algorithms to investigate the efficiency of the implementation of artificial intelligence models in conjunction with data driven lean management models. The extended version of the work will contain statistical tables and the numerical representation of the results with graphs and visualizations including AI probabilistic errors and evaluations.

The Main Contributions of the Work. The main contribution of the work consists in the description of connections among multiple variables either endogenous either exogenous, that are able to design essential characteristics of healthcare management. Specifically, we will focus not only on the logical and methodological applications of the AI-LM in healthcare, but also on the definition and evaluation of the associated metrics. The original contribution consists in the joint application of AI-LM in healthcare organizations. The literature presents various cases of application of AI in connection with LM in the manufacturing sector (Helmold, 2020), (Chen & Wang, 2022), (Perico & Mattioli, 2020), (Ahmed, et al., 2022), (Helmold, et al., 2022). Nonetheless, the conjunct application of AI and LM in the healthcare misses significant investigations in the scientific literature.

2 Data Analysis with the Application of OLS Models

We have used data from 445 Californian hospital in the period 2017-2018 (CHHS, s.d.). The dataset is composite since it contains either financial data from balance sheet either operational data able to represent the economic organization of the hospital. We choose to estimate the level of Net Income i.e. the difference between revenues and costs as a proxy for hospital efficiency. The estimation of the value of Net Income has been performed with the application of the OLS-Ordinary Least Square. We have estimated the following equation:

$$
\begin{aligned}
&\boldsymbol{NetIncome_t} \\
&= \boldsymbol{a_1} + \boldsymbol{b_1}(\boldsymbol{OtherSelectedUtilizationInformation})_t \\
&+ \boldsymbol{b_2}(\boldsymbol{GrossPatientRevenuebyRevenueCenterGroup})_t \\
&+ \boldsymbol{b_3}(\boldsymbol{ExpensesbyNaturalClassification})_t \\
&+ \boldsymbol{b_4}(\boldsymbol{SummaryIncomeStatement})_t \\
&+ \boldsymbol{b_5}(\boldsymbol{GrossInpatientRevenuebyPayer})_t \\
&+ \boldsymbol{b_6}(\boldsymbol{OutpatientVisitsbyPayer})_t \\
&+ \boldsymbol{b_7}(\boldsymbol{ProductiveHoursbyEmployeeClassification}) \\
&+ \boldsymbol{b_8}(\boldsymbol{HospitalPersonnelInformation})_t \\
&+ \boldsymbol{b_9}(\boldsymbol{DeductionsFromRevenue})_t + \boldsymbol{b_{10}}(\boldsymbol{Beds})_t \\
&+ \boldsymbol{b_{11}}(\boldsymbol{OtherBalanceSheetItems})_t \\
&+ \boldsymbol{b_{12}}(\boldsymbol{TotalPaidHourseByCostCenterGroup})_t \\
&+ \boldsymbol{b_{13}}(\boldsymbol{GrossOutpatientRevenueByPayer})_t \\
&+ \boldsymbol{b_{14}}(\boldsymbol{GrossInpatientRevenueByPayer})_t \\
&+ \boldsymbol{b_{15}}(\boldsymbol{SelectedFinancialItems})_t \\
&+ \boldsymbol{b_{16}}(\boldsymbol{DeductionsFromRevenueCont})_t \\
&+ \boldsymbol{b_{17}}(\boldsymbol{LicensedBedsAndUtilizationByTypeofCareCont})_t \\
&+ \boldsymbol{b_{18}}(\boldsymbol{ExpensesByNaturalClassification})_t \\
&+ \boldsymbol{b_{19}}(\boldsymbol{InpatientUtilizationByPayer})_t \\
&+ \boldsymbol{b_{20}}(\boldsymbol{TotalProductiveHoursByCostCenterGroup})_t \\
&+ \boldsymbol{b_{21}}(\boldsymbol{SummaryIncomeStatement})_t \\
&+ \boldsymbol{b_{22}}(\boldsymbol{NetPatientRevenueByPayer})_t \\
&+ \boldsymbol{b_{23}}(\boldsymbol{LicensedBedsAndUtilizationByTypeofCare})_t \\
&+ \boldsymbol{b_{24}}(\boldsymbol{HospitalPersonnelInformationCont})_t \\
&\boldsymbol{t = 2017}
\end{aligned}
$$

Each of the variable in the previous equation is a macro-variable. Each macro-variable has been as average of the single micro-variable that are indicated in the appendix. Specifically, the numerical values of the macro-variables have been calculated as the average of the single micro-variable pertaining the same macro-class. But, while the level of p-value is known for each micro-variables, the same value is not relevant in the case of the discussion of macro-variables. The passage from micro-variables to macro-variables has been realized to solve the question of the synthetic representation of the results in the context of AI-LM. In the following table we have the representation of the macro-class of variables, while the complete regression results for the micro-variables is presented in the appendix.

Estimation of Net Income in 445 Californian Hospital by Macro-Class of Variables		
b_1	Other Selected Utilization Information	8,85598
b_2	Gross Patient Revenue by Revenue Center Group	0,903513
b_3	Expenses by Natural Classification (Con't)	0,903081

b_4	Summary Income Statement	0,503691
b_5	Gross Inpatient Revenue by Payer	0,463342
b_6	Outpatient Visits by Payer	0,321771
b_7	Productive Hours by Employee Classification	0,171544
b_8	Hospital Personnel Information	0,127416
b_9	Deductions from Revenue	0,125717
b_{10}	Beds	0,124578
b_{11}	Other Balance Sheet Items	0,079718
b_{12}	Total Paid Hours by Cost Center Group	0,064797
b_{13}	Gross Outpatient Revenue by Payer	0,000525
b_{14}	Gross Inpatient Revenue by Payer	-0,00177
b_{15}	Selected Financial Items	-0,03231
b_{16}	Deductions from Revenue (Con't)	-0,10894
b_{17}	Licensed Beds and Utilization by Type of Care (Con't)	-0,14698
b_{18}	Expenses by Natural Classification	-0,2273
b_{19}	Inpatient Utilization by Payer	-0,32652
b_{20}	Total Productive Hours by Cost Center Group	-0,86809
b_{21}	Summary Income Statement (Con't)	-1,01506
b_{22}	Net Patient Revenue by Payer	-3,35907
b_{23}	Licensed Beds and Utilization by Type of Care	-128149
b_{24}	Hospital Personnel Information (Con't)	-5,74E+07

In synthesis the two macro-variables that have the higher level of positive relationship in determining the value of Net Income area:

- *Other Selected Utilization Information*: i.e. a variable that consider the level of caesarean sections. There is a positive relationship between the level of Cesarean Section and the level of Net Income.
- *Gross Patient Revenue by Revenues Center group*: this is a macro-variable that is constituted by three different variables i.e.: Gross Patient Revenue Daily Hospital Services, Gross Patient Revenue Ambulatory Services and Gross Patient Revenue Ancillary Services. Specifically the calculation of the value of Gross Patient Revenue by Revenue Center Group has been calculated as the average of the three components. There is a positive relationship between Gross Patient Revenue by Revenue Center Groups and the level of Net Income.

The two macro-variables that have the most negative effect on Net Income are:

- *Licensed Beds and Utilization by Type of Care:* the value of this macro-variable has been built as an average of the following micro-variables i.e. Licensed Beds Acute, Licensed Beds Psychiatric, Licensed Beds Chemical Dep, Licensed Rehabilitation, Licensed Beds Residential & Other Daily Services, Patient Days Psychiatric, Patient Days Chemical Dep, Patient Days Long-Term Care, Patient Days Residential & Other Daily Services. All these micro-variables have negative and statistically significant coefficient as showed in the Appendix. Licensed beds are beds that the hospital can offer based on the authorization of the authority. The number of licensed beds can differ from the number of staffed beds that are the beds effectively feasible in the hospital. There is a negative relationship between the number of licensed beds and the level of net income. Hospitals that have a greater number of licensed beds have fewer probabilities to increase their net income.
- *Hospital Personnel Information (Con't):* is the number of physicians. It comprehends either hospital-based physicians either non-hospital based physicians. Physician in this category are distinguished in Attending, Associate and House Staff. There is a negative relationship between Hospital Personnel Information and Net Income. This means that hospitals that have a greater number of medical staff have lower probabilities to have a positive level in terms of Net Income.

In any case it is necessary to underline that out analysis has some limitations due to the fact the OLS is a not-profound kind of regression. It will be necessary, in further development of the article, to analyse and compare OLS with deeper regression models i.e. Panel Data with Random Effects, Panel Data with Fixed Effects, and Dynamic Panel.

3 Clusterization with k-Means Algorithm Optimized with the Elbow Method

In the following part, we propose a clustering analysis based on k-Means algorithm optimized with the Elbow Method. Results show the presence of five clusters. Calculating the median of each cluster, it is possible to derive an order of clusters based on Net Income. We found the following order of clusters: C1>C3>C2>C4>C5. The cluster 3 has the greatest number of hospital with a value equal to 229 units. The clusterization offers an indication of the level of

financial and economic efficiency of the Californian Hospitals. Specifically we found that 51% of the hospitals have a medium-high level of financial and economic performance. On the other side there are 52 hospitals that have a median value of zero in terms of Net Income.

The presence of a series of hospitals that have a level of Net Income equal to zero is due to missing data. In effect there are hospital for which many of the variables of the balance sheet are empty. Furthermore, we have to consider that, independently from the proposed cluster analysis there are a set of hospitals that are part of the same corporations. The most relevant conglomerate of hospitals are indicated as follows:

- 13 hospitals are part of the conglomerate Adventist Group;
- 32 hospitals are part of the conglomerate Kaiser Foundation;
- 10 hospitals are part of the conglomerate Kindred Hospitals;
- 15 hospitals are part of the conglomerate Sutter.

These conglomerates show that the market of hospitals in California is oriented to a compositions the is far for a pure competition and that is more oriented to the creation of organizations that have a monopolistic tension.

4 Prediction with Machine Learning Algorithms for the Estimation of the Value of Net Income in a set of 445 Californian Hospital in the Period 2014-2018

In the following section, we present a prediction with eight machine-learning algorithms. Algorithms are compared based on their ability to minimize statistical errors and maximize R-squared. Specifically we have used three kind of statistical errors that are: Mean Squared Error, Mean Absolute Error, Root Means Squared Error. The ranking that each algorithms has in each ranking for each statistical measures has been summed in a global ranking. The lower the total payoff that an algorithm receive the highest the predictive ability. Algorithms has been trained with 70% of the dataset, while the remaining 70% of the data have been used to the prediction. Specifically, we have used data of 445 Californian Hospital using data for the period 2014-2018. We have then predicted the level of Net Income of the 30% of the hospital for the next financial exercise i.e. 2019. The order of algorithms based on their predictive ability is as follows:

- ANN-Artificial Neural Network with a payoff equal to 4;
- Gradient Boosted Trees with a payoff equal to 8;

- Polynomial Regression with a payoff equal to 12;
- Linear Regression with a payoff equal to 17;
- Simple Regression and Random Forest Regression with a payoff equal to 22;
- Tree Ensemble Regression with a payoff equal to 27;
- PNN-Probabilistic Neural Network with a payoff equal to 32.

Statistical Errors of the Machine Learning Algorithms Used for the Prediction of the level of Net Income in a Set of Californian Hospital				
Statistics	**ANN**	**PNN**	**Simple Regression**	**Gradient Boosted Trees**
R^2	0,825049656	0,224600532	0,657045860	0,796033238
Mean absolute error	0,014669577	0,019674844	0,018658046	0,014900856
Mean squared error	0,001000000	0,003409605	0,001508046	0,001000000
Root mean squared error	0,027736181	0,058391821	0,038833568	0,029948079
Statistics	**Random Forest Regression**	**Tree Ensemble Regression**	**Linear Regression**	**Polynomial Regression**
R^2	0,628001542	0,60642641	0,710486929	0,755067032
Mean absolute error	0,016991015	0,0175289	0,017042984	0,016266271
Mean squared error	0,001635760	0,00173063	0,001273054	0,001077025
Root mean squared error	0,040444534	0,04160085	0,035679877	0,032818059

The output of the prediction is applied to 133 hospitals. We found that on average the level of NET Income for the 133 hospitals is expected to growth at 4,01%. Specifically there are 86 hospitals for which the level of Net Income is expected the growth and 47 hospitals for which the level of Net Income is expected to diminish. If we consider only the subset of the 86 hospitals for which it is expected a growth in Net Income we have an average level of growth equal to 15,83%. Otherwise, if we consider the subset of the 47 hospitals for which there is a negative level of Net Income, we found an average level of Net Income that is expected to diminish to -17,64%.

The hospitals for which it is expected a greater level of growth in Net Income are:

- Valley Presbyterian Hospital with a level of Net Income that is expected to growth of 129,11%;

- Lac/Rancho Los Amigos National Rehabilitation Center with a Net Income that is expected to growth of 73,22%;
- Sequoia Hospital with a Net Income that is expected to growth of 66,3%;
- Chino Valley Medical Center with a Net Income that is expected to growth of 60,25%;
- Redwood Memorial Hospital with a Net Income that is expected to growth of 57,75%.

If we consider the 47 hospitals for which the level of Net Income is expected to diminish we found that the following hospitals have the worst levels:

- Los Alamitos Medical Center with a Net Income that is expected to diminish of the -34,18%;
- Doctors Hospital of Manteca with a Net Income that is expected to diminish of -36,22%;
- Lac/Harbor-Ucla Medical Center with a Net Income that is expected to diminish of -38,25%;
- La Palma Intercommunity Hospital with a Net Income that is expected to diminish of -57,39%.

Ranking of Algorithms based on their Predictive Ability					
Algorithms	**R^2**	**MAE**	**MSE**	**RMSE**	**SUM**
ANN-Artificial Neural Network	1	1	1	1	4
Gradient Boosted Trees	2	2	2	2	8
Polynomial Regression	3	3	3	3	12
Linear Regression	4	5	4	4	17
Simple Regression	5	7	5	5	22
Random Forest Regression	6	4	6	6	22
Tree Ensemble Regression	7	6	7	7	27
PNN-Probabilistic Neural Network	8	8	8	8	32

5 Conclusions

In this article we have analysed data from 445 Californian hospitals in the period 2014-2018. We have performed a regression analysis with OLS-Ordinary

Least Squares and we found a set of connections among various macro-variables showing that Net Income increases, among others, with Caesarean Sections and Ambulatory Services. But, we also find that Net Income reduces, among others, with the increase of the number of physicians and the number of beds.

These results are interesting since they found the presence of areas in which it is possible to intervene to reduce the inefficiency i.e. the cost of beds and the costs of physicians. In this sense, it is possible to act with lean management tools and AI to monitor the performance of physicians and to promote a better financial sustainability of the costs of bed. For example, a better organization of the work of physicians assisted with telemedicine tools can reduce significantly the costs of the hospitals and promote a better result in terms of Net Income. On the other side the most efficient activities for the set of Californian hospitals analysed are caesarean sections and a set of services i.e. daily hospitals, ancillary services ambulatory services.

Furthermore we have applied a cluster analysis with the k-Means algorithms optimized with the Elbow Method. Results show the presence of five clusters. The vast majority of the hospitals are in the clusters with the highest level of Net Income i.e. Californian hospital show, as aggregates, a medium-high level of economic, financial and operational performance.

Finally, we propose a confrontation among eight different machine learning algorithms for the predictions of the future level of Net Income based on data on the period 2014-2018. We found that on 133 hospitals for which the future level of Net Income is predicted there is an expected average growth of Net Income of 4%. In any case the number of hospital for which the level of Net Income is expected to growth is equal to 86 while the number of hospital for which the Net Income is expected to diminish is equal to 47.

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Process Mining Applied to Lean Management Model Improving Decision Making in Healthcare Organizations

Angelo Rosa

Lum University "Giuseppe Degennaro"
Strada Statale 100 km 18, 70010 Casamassima BA

Alessandro Massaro*

Lum University "Giuseppe Degennaro"
Lum Enterprise s.r.l.
Strada Statale 100 km 18, 70010 Casamassima BA

Olivia McDermott

National University of Ireland
Ireland

** Corresponding author*

Abstract

The paper introduces an innovative approach to model risks in healthcare finding possible solutions in organization models and about Human Resources (HR) managing. Specifically, the method is based on the application of the Business Processing Modelling and Notation (BPMN) workflows in healthcare environments merging Lean management methods and Artificial Intelligence (AI) decision making approaches. The discussion begins with a case study about risk management integrating AI to enable a Decision Support System (DSS) thus defining the innovative BPMN Process Mining (PM) models. The BPMN-PM models are based on AI risk prediction and AI risk classification suitable to optimise the whole HR organizational model. In the specific case study, the AI algorithms allows the optimization of risk assessment. Finally, the work discusses some theoretical BPMN-PM models to integrate in more complex healthcare processes managing efficiently HR. The proposed work provides information about the process design and the key-reading to interpret BPMN-PM workflows

Keywords – Business Process Modelling and Notation –BPMN-, Process Mining, Artificial Intelligence, Healthcare DSS

Paper type – Academic Research Paper

1 Introduction

The Business Process Modelling and Notation (BPMN) is a standard graphical notation (ISO/IEC 19510:2013) suitable to map processes (Massaro, 2021). In healthcare environments, BPMN is applied to design emergency care processes involving Human Resources (HR) (Pufahl, 2022) and is suitable for workflow simulations (Ongoo et al., 2018). BPMN is also an important tool to design Integrated Home Care (IHC) processes (Russo et al., 2015). On the other side, Process Mining (PM) is an innovative approach to optimize processes in industries, including organizational aspects, by means the integration of Artificial Intelligence (AI) algorithms in BPMN (Massaro, 2022 a; Massaro 2022 b): it is possible to integrate PM model into a BPMN workflow constructing an intelligent BPMN-PM decision making engine. The innovative aspect of the PM is the implementation of AI in the management processes enabling the automation of tasks and actions to perform in real time. The process automation is suitable to increase the efficiency in healthcare processes supporting the estimation of important Key Performance Indicators (KPIs). KPIs are defined in different application fields of healthcare processes including the basic ones such as costs, time delays, HR efficiency, and in general processes management. BPMN is also adopted to map Lean production processes in industries (Naciri et al., 2022). In healthcare, the Lean method is applied to solve organizational aspects (Bossone et al., 2022; Rosa, 2017). For the first time the proposed work shows the possibility to match BPMN-PM models with the Lean management approach by analysing a case study involving organization improvements of HR. This matching is possible because public institutions are moving quickly towards digital processes using software platforms allowing interoperability and data processing (digital transformation of public institutions and major availability of digital data to process). In this direction, the Covid19 scenario introduced a new approach tailoring processes by means of digital data and data analytics to decrease the pandemic risk (Elia, 2022). The need to merge organizational clinical procedures with the risk management processes using digital data, 'launched' the adoption of "digitised processes" enabling risk monitoring procedures and patient management processes. This aspect enhances the need to design and map processes integrating data processing methods. An important aspect to consider to map processes is the definition of procedure to perform. The procedure

adopted for the case study is based on the following standard steps typical of engineered school:

- **Step 1:** preliminary analysis institution's organigram to establish the actors to interview (first the sector managers, and then the individual workers);
- **Step 2:** mapping of the 'AS IS' process by means of interviews with responsible of a specific process to analyse (the questions are prepared before according to the case study to map representing a specific application field);
- **Step 3:** definition of the critical points emerging from the 'AS IS' analysis (critical aspects deducted from the interviews);
- **Step 4:** mapping (design) of the 'TO BE' workflow process enhancing solutions found for the critical points, and adding possible KPIs useful for the monitoring of the new designed workflow;
- **Step 5:** simulation of the 'TO BE' process to perform before the execution of the designed process;
- **Step 6:** execution of the 'TO BE' workflow by estimating KPIs (to be considered for a re-engineering of the whole process).

All the steps are included into a Plan Do Check Act (PDCA) model, where the Plan phase is the 'TO BE' process following the 'AS IS' one, the Do action concerns the execution of the 'TO BE' process, the Check is the process monitoring, and the ACT represents the final tailored process.

Specifically, the example discussed in the paper is related to the 'TO BE' process of an Italian public healthcare institution concerning patient fall risk assessment improved by a lean management approach supported by data analytics and PM. Starting to the case study the paper develops correlated BPMN-PM theoretical models based on a Lean management approach. The work is structured as follows:

- description of the symbols used for the BPMN workflows facilitating the process reading;
- presentation of the BPMN-PM model of a case study related a risk management model in healthcare (case study implementing the BPMN-PM model);
- developments of further theoretical BPMN-PM models improving the 'TO BE' healthcare organization deducted from the analysed case study (structuration of the organizational model);

- conclusions discussing advantages and perspectives about implementations of BPMN-PM approaches.

2 Main BPMN Symbols Mapping workflows

The symbols adopted for the BPMN models are the following:

- '*Pool*' containing the symbols of a process or of a sub-process;
- Event '*Start*' defining the begin of a process or of a sub-process;
- Event '*Start with a notification*' defining the begin of a process or of a sub-process following a request;
- '*Task box*' representing the actions to perform into the workflow;
- '*Timer*' event indicating a periodicity of an action to perform;
- '*Database*' symbol (local data repository or big data system);
- '*End*' event (end of a process/sub-process);
- '*Message End*' (end of a process/sub-process with a message/notification);
- '*Exclusive Event based*' gateway expressing decision making logics;
- '*Arrow line*' indicating the fluxes of the processes;
- '*Dashed line*' indicating the interconnections between two or many different '*Pools*'.

In order to facilitate the reading of the workflows are adopted for the '*Task boxes*' different colours having the following meaning:

- orange colour indicating the digital data;
- green colour indicating a matching with lean management procedures;
- red colour enhancing the DSS engine integrating the PM model or the AI algorithms improving the decision making actions.

As further symbols adopted to model task are used the dashed line '*Task box*' for an assessment of a particular condition, and the bold edges of box to enhance an important task. The '*Task box*' superimposed between two pools indicates an action to be executed by two processes or sub-processes (two different '*Pools*' executing the same task).

3 BPMN-PM Model Applied to an Italian Case Study

The first step adopted to design a 'TO BE' process for the case study, is to map the actual 'AS IS' process providing important information about critical points. In the specific analysis, a critical point is found in the risk management process

about the falls in the hospital rooms. In Fig. 1 is illustrated the 'TO BE' BPMN workflow optimizing risk assessment procedures and sketching the PM model. As previously discussed, the BPMN is typically adopted to model processes by allowing the possibility to simulate all the sub-processes. This is an important aspect to comprehend the whole studied scenario by considering all the cases involved in the sub-processes. We observe that the proposed BPMN diagram is a simplification of a more complex workflow which takes into account other system actors (in the proposed example there are only three '*Pools*' indicating the three main actors of *Risk management Unit*, *Operative Unit*, and *Medical Direction*). The model considers the following important tasks improving the fall risk management procedure:

- introduction of a tablet or of a mobile app for the digital traceability (digital transformation of the 'AS IS' process) of all events about patient fall conditions and cases (recording of digital data useful for data analytics);
- a new procedure about the reorganization of resources and nurses to improve the organization about the monitoring (lean management of the risk monitoring);
- a HR learning plan able to optimize the checks of the events and the risk assessment (lean management approach about learning organization);
- a new approach for the monitoring of corrective actions by the introduction of effective corrective elements as outputs of the optimization of the organizational management;
- the check of the electronic health records to update the Conley tab (Guzzo et al., 2015) initially filled when the patient enters the hospital room (important aspect to update information useful for the monitoring procedure);
- an advanced data analytics performed by the Decision Support System (DSS) engine implementing AI algorithms (supervised self-learning algorithms used for prediction and for classifications, and unsupervised ones adopted for data clustering).

The main innovative aspect of the model is represented by the DSS highlighted in red in the figure, enabling advanced data analytics (correlation results and data clustering), risk prediction, and risk classification. The workflow of Fig. 1 indicates also the tasks involving directly the lean management approach (green colour)

and the digital data sources (orange colour). The decision making could be therefore optimized by finding by AI algorithms 'hidden' correlations between risk's variables, by classifying new classes of risks, and by predicting the risks. The further advantage of the DSS is the possibility to compute different variables by optimizing the predictive results by training the model through the processing historical dataset contained in the backend of the management platform (database of the software platform).

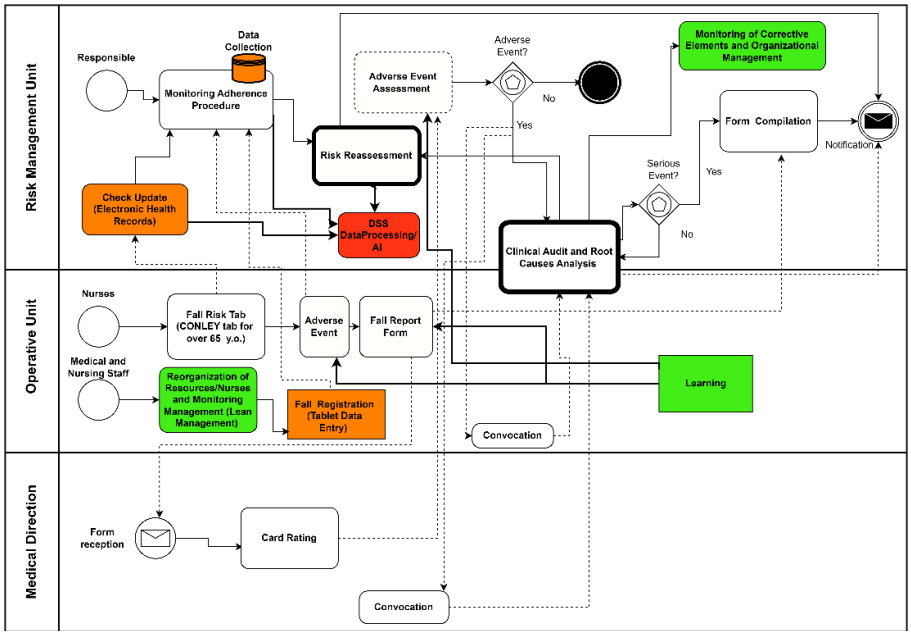

Figure 11. BPMN 'TO BE' model of the fall risk assessment (orange colour indicates digital data, green colour represents tasks involving lean management solution, and red colour highlights the DSS engine implementing Process Mining).

4 BPMN-PM Models and Healthcare Organization Improvements

The case study discussed in the previous section allows to develop new BPMN-PM models supporting HR organization in healthcare environments. Possible 'TO BE' improvements in organizations is described by the BPMN-PM workflow of Fig. 2 defining the AI risk assessment linked to the analysed case study. Specifically, the designed workflow is explained as follows (workflow simulation performed by analysing the use cases):

- if the risk assessment provides a high risk score, will be required urgent interventions about a reengineering plan of HR allocation, consecutively updating the organizational plan;
- if are not checked risk conditions, it is enabled the AI engine providing risk predictions (condition enabling AI data processing);
- if are predicted risks, will be applied interventions (non-urgent interventions) about the HR allocation, consecutively updating the organizational plan;
- if are not predicted risks no actions will be performed;
- the risk assessment is performed periodically according to the indications contained into the updated organizational model.

We observe that the workflow of Fig. 2 is a self-adaptive model: the feedbacks allow to update periodically the organizational model according to the risk assessment and to AI risk prediction results supporting the reengineering of the HR organization in the medium-long period.

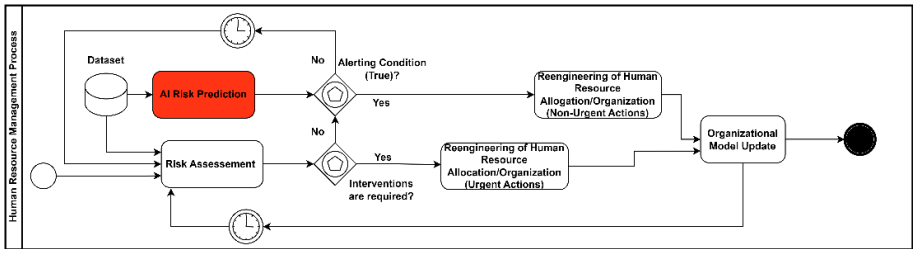

Figure 2. BPMN 'TO BE' model of the HR organisational model construction by means of risk assessment and AI risk prediction.

Figure 3 'explodes' an example of the organizational model indicated in Fig. 2. The workflow is characterised by the following three levels of actions:

- **Action 1**: enabling a learning plan and actuating it;
- **Action 2**: enabling a re-allocation of HR;
- **Action 3**: adding action of HR.

Action 1 is executed when it is evaluated that is enough a formative plan to solve a problem associated to a risk. If after the execution of the formation plan the problem is not solved, it is checked the possibility to activate Action 2 and Action 3 in sequence. For the particular case that also the Action 3 is not required, it is performed the re-analysis about the AI risk classification. Starting to the update of the risk classification (merging

information about risk assessment), it is again followed the iterative cycle.

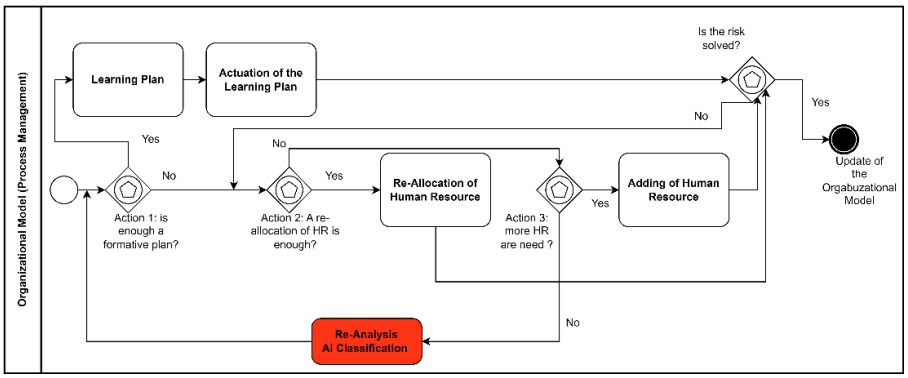

Figure 3. BPMN 'TO BE' model of the human resource organisational model construction by means of a sequential combination of different processes (Learning, Re-allocation, and Adding HR).

The learning plan must be designed after a check of the HR availability and of all competences. This allows to intervene with precision in each single process. The plan is addressed mainly to the upskill of HR. The allocation of HR should be managed according to feasible solutions and real needs.

5 Conclusions

The goal of the proposed process is to optimize the risk assessment procedure by decreasing the falls in the hospital rooms by adopting a dynamic process able to update efficiently the risk evaluation criteria and the corrective elements. The used approach merges different concepts and methods such as the lean management approach, BPMN mapping, and PM models. Starting to the analysis of a case study, the proposed work defines intelligent organizational models enhancing the AI role in risk decision making. The advantages of the BPMN-PM models can be summarized in the following main points:

i) a clear definition of the responsibilities and roles in the process to be executed,
ii) the formulation of new procedures to follow avoiding possible risks and process failures;
iii) possibility to simulate the process before to be executed (testing of the process analysing all the workflow cases);

iv) possibility to check dynamically the correct execution of the process (as for synoptic dashboards able to monitor in real time the performed tasks for each phase of the process);
v) possibility to translate listed procedures by means of a graphical workflow;
vi) improvement of procedure quality;
vii) improvement of process efficiency (monitoring KPI in different stages of the process);
viii) automated updating of the plan managing HR;
ix) a significant decrease of risks;
x) a clear indication of the AI role in the whole decision making process;
xi) the assessment of risk levels updating the risk classification;
xii) a possible decrease of costs (related the specific mapped process);
xiii) a simple way to update quickly the process visualizing their characteristics (process re-engineering).

The perspectives of the BPMN-PM model about lean management in healthcare applications are mainly in a new 'concept' to manage HR and related processes. A possible implementation of AI in decision making could reduce drastically the patient's risks and optimize the whole management of HR. AI algorithms are able to find possible correlations between risk variables thus updating the risk assessment criteria and the risk classification. The international standard notation BPMN is a good way to fix the correct execution of advanced processes characterized by AI analytics. Future works will be addressed on specific data processing and KPI estimation.

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The Role of Woman in Crisis Management: The Case of Sport-Based Entrepreneurship

Raffaele Trequattrini

Department of Economics and Law
University of Cassino and Southern Lazio
Via S. Angelo, Loc. Folcara, 03043, Cassino (FR), Italy

Alessandra Lardo

Department of Business and Economics
Parthenope University of Naples
Via Generale Parisi, 13

Benedetta Cuozzo

Department of Economics and Law
University of Cassino and Southern Lazio
Via S. Angelo, Loc. Folcara, 03043, Cassino (FR), Italy

Alberto Manzari*

Department of Economics, Management and Business Law,
University of Bari Aldo Moro,
Largo Abbazia Santa Scolastica, 53, 70121 Bari (BA), Italy

** Corresponding author*

Abstract

This paper investigates the role of women who hold top-level positions in the management of firms in managing and overcoming the corporate crisis. The research's main goal relies on discovering the extent to which gender differences affect perceived crisis proneness/preparedness in organisational settings in sport-based entrepreneurship. In particular, we aim to study actions, decision-making, abilities, and opportunities women can exploit to strategically run the business during a crisis.

The research question is answered through a single case study approach based on the basketball club "Virtus Cassino", which participates in the Italian national Serie B basketball championship. We conducted semi-structured interviews with the woman entrepreneur. We analysed strategic business documents, the website, and articles published in the press on Virtus Cassino. Therefore, the female entrepreneur figure represents a vital aspect of the analysis conducted and the strategic management model of crisis management. The

Ratten (2011) and Ahonen (2019) frameworks were used to test our results in achieving the research aims. Finally, a triangulation of the research results was conducted to attest to the integrity and reliability of the data. The paper enriches the literature on gender and crisis by providing a strategic management model for crisis management in sports entrepreneurship, guided by a female entrepreneur. The results of this research contribute to the literature also on sport-based entrepreneurship and entrepreneurship theory, identifying the strategic levers of crisis management guided by a female entrepreneur, including intangible elements such as the manager's entrepreneurial skills, the cultural background of the factors, the relationships established by the sports club with fans and specialized figures in the sector. This model helps to understand how the role of women, even in sports enterprises, can be considered valuable for overcoming corporate managerial crises.

Keywords – Gender, crisis management, sport, entrepreneurship, innovation

Paper type – Academic Research Paper

1 Introduction

This study aims to address three topics of growing interest both at a practical and academic level: i) female entrepreneurship; ii) the organizational management of companies with high cognitive intensity, such as sports clubs; iii) the challenges of running a business during turbulent times, such as lack of satisfactory sporting results.

Our primary focus is to investigate the role of women who hold top-level positions in the management of firms in managing and overcoming the corporate crisis. The research's main goal relies on discovering how gender differences affect perceived crisis proneness/preparedness in organizational settings in sport-based entrepreneurship. The paper of Kanter (1977) on gender differences in management styles heralded a growing academic interest in gender sameness/difference concerning organizational issues. Scholars are increasingly focusing on the results at the corporate level determined by the effects of gender-based differences (Druskat, 1994; Gherardi, 1996; Tomlinson et al., 1997; Rosener, 1990).

"Crisis preparedness is defined as a state of corporate readiness to foresee and address endogenous or exogenous threats liable to inflict a multidimensional crisis by consciously recognising and proactively preparing for their inevitable occurrence" (Sheaffer and Mano-Negrin, 2003). This paper aims to discover the emerging strategic management model able to contrast the enterprises' crisis in

sport-based female entrepreneurship. We study the management activities, actions, decision-making, abilities and opportunities to overcome the corporate crisis.

The research question is answered through a single case study approach (Berg, 2007; Yin, 2014) based on the basketball club "Virtus Cassino", which participating club at the Italian national Serie B championship. We conducted semi-structured interviews with the female entrepreneur assuming the club's board role. Therefore, the female entrepreneur figure represents a vital aspect of the analysis undertaken and the strategic management model of crisis management. We adopted the Ratten (2011) framework and the Ahonen (2019) framework as interpretative lenses to test our results in achieving the research aims. Finally, a triangulation of the research results was conducted to attest to the integrity and reliability of the data.

The paper is novel because it provides a renewed strategic management model for crisis management in sport-based female entrepreneurship. This model is mainly based on intangible factors deriving from innovation, proactiveness, abilities, risk-taking, and orientation owned by the entrepreneur.

We show how the results outline a renewed strategic management model of crisis management based on multiple intangible levers supporting sport-based entrepreneurship. Leadership, risk-taking, capabilities, choices, and ideas are essential in the company recovery process. The results of this research contribute to the literature on sport-based female entrepreneurship, identifying the strategic levers of crisis management, including: i) intangible elements such as platforms for choosing the best athletes on the market, ii) interactions with the right stakeholders to increase the club's possible results, iii) innovative strategies to increase fan-based on social networks and box office revenues, and iv) engagement strategies to increase brand awareness. This model is extensible and applicable to all enterprises, not just the sports ones, developing a new crisis management model.

The remainder of the paper is organised as follows: Section 2 examines relevant literature. Section 3 presents the research methodology. Section 4 presents the findings. Lastly, Section 5 presents the discussion and conclusions of the paper.

2 Literature review and research question

2.1 Female entrepreneurship in the sports industry

Inequality and discrimination against the female gender have been the subject of global debate, and in particular, in recent decades, research has focused on finding strategic means in business and organizational contexts to encourage greater involvement of women (Baughn et al., 2006; Henry et al., 2016; Yadav and Unni, 2016; Poggesi et al., 2016). Various institutional bodies, such as the United Nations and the European Institute for Gender Equality (GEM), have tried to find solutions to this problem. Still, at present, the involvement of women in entrepreneurial initiatives could be much higher. A study by the GEM (GEM, 2019), gender inequality in the total entrepreneurial activity rate (TEA) remains high, with women's TEA reaching just 5% in many European countries. Consequently, there has been a growing interest on the part of scholars towards the phenomenon of gender inequality from the point of view of entrepreneurial initiatives (Cabrera and Mauricio, 2017) given the subject's nature which transversely affects various fields of knowledge. In this issue, scholars identify universities as institutions capable of exerting a considerable influence in stimulating an entrepreneurial attitude (Kogut and Mejri, 2022). Universities have an essential educational role in addressing the issue of gender equity to promote women's self-confidence and encourage them to develop entrepreneurial initiatives (Bianchi et al., 2016; Carter et al., 2006); therefore, the higher the education level, the higher the rate of entrepreneurship (Corrêa et al., 2022). The scholarly debate on gender inequality from the point of view of entrepreneurial initiatives crosses several sectors, including sports (Meier, 2000). As supported in studies developed in other productive sectors (Senne, 2016), sports entrepreneurship continues to be culturally associated with the male gender (Sotiriadou and De Haan, 2019). Thus, the problems in the social environment stem from the reality that women entrepreneurs live in a patriarchal society. Turkmen (2015) also argues that further problems identified on the subject are essentially two: i) the absence of female entrepreneurs in the sports sector who can lead and be a model for other women who intend to develop entrepreneurial initiatives; ii) the lack of family support, especially from the husband. Several authors have determined a relationship between the practice of physical/sports activity and the development of entrepreneurial intention levels. From an in-

depth analysis of various contributions on the issue, it is possible to state that women still encounter many obstacles when developing entrepreneurial initiatives. Still, they must keep trying to overcome the cultural barriers and the social contexts they operate presently.

2.2 Crisis Management and sport-based entrepreneurship

Corporate crises are often unexpected and unpredictable events influencing organizations, among which enterprises (Apostol et al., 2015; Coombs, 1999; David, 2003; Loewendrick, 1993; Paraskevas, 2006). Mainly, corporate crises determine several effects inside and outside the enterprises on the financial and non-financial performance, relationship with employees, reputation, stakeholders and so on (Barton, 1993). Thus, crisis management is necessary for the survival of enterprises trying to delete adverse effects in the organization and in its environment (Pearson and Mitroff, 1993).

Corporate crises are often investigated as the moment or period in which an enterprise faces difficulties, influencing its objectives, strategic decision-making and performance (Fink, 2002; Hart, 1993; Maynard, 1993; Mitroff, 2004; Shrivastava, 1987). Addressing corporate crisis, seven groups of events are recognized (Mitroff, 2004): i) economic problems; ii) information problems; iii) problems with company plants; iv) problems affecting human resources; v) reputational problems; vi) problems deriving from psychopathic acts; vii) problems deriving from natural disasters.

Only some enterprises have comprehensive crisis management plans sometimes included in their strategic process (Pollard and Hotho, 2006; Shrivastava and Mitroff, 1987).

Crisis management is developed through the strategic direction of enterprises assuming strategic and emergency planning to overcome the crisis (Bugge, 1993; Counts and Prowant, 1994; Lagadec, 1996; Mitroff, 2004; Preble, 1997; Perry and Nigg, 1985; Quarantelli, 1996; Sylves and Pavalak, 1990). Enterprises must develop a safety culture within the organizations and their environment (Gherardi, 2009; Pidgeon, 1991).

Entrepreneurship is a complex phenomenon crossing economic sectors (Low and McMillan, 1988) and investing in knowledge-intensive industries, new initiatives and technology-based sectors (Burgel and Murrat, 2000). Even if many entrepreneurship definitions exist (Ahmad and Seymour, 2008; Anderson et al.,

2008; Bygrave et al., 1992; Gartner, 1990; Malerba and Mckelvey, 2016; Venkataraman, 1997), its investigation allows to recognize several elements, among which the profitable business opportunities, ability and skills, performance by entrepreneurs (Covin and Slevin, 1991; Mitchelmore and Rowley, 2010; Muzychenko, 1992; Sambasivan et al., 2009; Shane and Venkataraman, 2000). Entrepreneurship is a process in which entrepreneurs seek opportunities without losing attention to financial resources (Stevenson and Jarillo, 1990).

Enterprise growth is related to the enterprise's success (Davidsson et al., 2006) depending on multiple external and internal factors (controllable and not uncontrollable). Entrepreneurial growth is recognized through the following elements (Ahonen, 2019; Hyrsky and Lipponen, 2004): i) growth orientation, ii) growth capacity, iii) ability to gain competitive advantages and iv) ability to seek market opportunities. The following indicators can be traced back to specific actions implemented by the enterprise.

The enterprises growth also depends on the manager's skills, competencies, knowledge, and ability to obtain and coordinate resources (Shane and Venkataraman, 2000).

Enterprises with a strong entrepreneurial orientation are willing to take risks, be innovative, proactive and oriented towards opportunities (Wiklund et al., 2009; Covin and Slevin, 1991), especially in sports entrepreneurship (Ratten, 2011; Ciletti, 2012). Both sport and entrepreneurship have many common characteristics demanding i) innovation, ii) proactivity and iii) risk-taking, and attention in a turbulent environment (Holt et al., 2007; Ratten, 2011). Sports entrepreneurship develops through activities responding to market opportunities and creating long-term value (Ratten, 2019).

Various entrepreneurial opportunities exist, and entrepreneurial activities are necessary for their development (Ciletti, 2012; Ratten, 2011; Santomier, 2002).

In light of the previous literature review, the research question is as follows:

> *RQ1. How does the female entrepreneur face crisis management in sport-based entrepreneurship?*

3 Methodology

We adopted the case study methodology (Yin, 2014) to answer our research question "RQ1. How does the female entrepreneur face crisis management in sport-based entrepreneurship?". The case study allows us to understand ''a how

or why the question is being asked about a contemporary set of events over which the investigator has little or no control" (Yin, 2014, p. 14). Additionally, we intend to "... capture various nuances, patterns, more latent elements that other research approaches might overlook" (Berg, 2007). In this perspective, a qualitative method is adopted to understanding the relationships between variables in complex processes (Shah and Corley, 2006).

We have proposed a single case study of sports entrepreneurship of one of the best and few sports clubs operating in the basketball sector, which finds a woman in the top position of president and sole director: the basketball club "Virtus Cassino". Donatella Formisano, the club's president and majority shareholder, is an appropriate subject for this study because she represents an excellent example of a female entrepreneur with personal values and characteristics that influence the decision-making process and the club's results. Between the 2018-19 and 2019-20 basketball seasons, the club faced a critical managerial crisis due to the poor sporting results achieved on the pitch. For this reason, the approach of the single case study allows an analysis of Virtus Cassino and of the characteristics and personal values of its woman entrepreneur Formisano, who was then able to raise the sporting fortunes of the club through important strategic and corporate decisions.

Therefore, the research conducted, considering the important role assumed by its female entrepreneur, aims to determine the entrepreneur's influences on strategic decisions and on the results achieved by Virtus Cassino in turbulent contexts and times. In light of what has been described, understanding is retained from the case study as a relevant and complex process.

The following subsections describe the research context, data collection, and analysis methods.

3.1 Research context, case study design, reliability and validity.

The research context of this study derives from the analysis of the Virtus Cassino sports club, directed by the female entrepreneur Donatella Formisano, and how through her knowledge and skills, the company has come out of a crisis of managerial and sports results.

Case study research is popular amongst sports organizations or sport policy studies (Skille, 2013) since it can be used to more deeply understand some aspects that have yet to be studied to a great extent.

The basketball club of the study, SSD a RL Virtus Cassino, is one of the emerging sports clubs in the Italian national basketball scene. After the first successful years characterized by victories in the Italian championships of Serie D, Serie C and Serie B, the first managerial and sporting crisis was recorded in the 2018-19 season due to the relegation from Serie A2 back to Serie B.

In Serie B, the new 2019-20 season opens with just one win in 15 games. A trend that forces administrators to change coaches and many players to reverse the bad sporting results achieved. Thanks to the choices made by the club, from the last position in the standings, the club rose to 13th place.

After the period of managerial crisis experienced by the club, the club still plays in the Serie B championship with excellent sporting results achieved on the field.

Therefore, our research focus will focus on the last period subject to context analysis and how the female entrepreneur's entrepreneurial skills at the company's head were fundamental in overcoming the managerial and sporting crisis that Virtus Cassino experienced.

We have analyzed various aspects of the life of a sports club and how Virtus Cassino develops each of them: from topics such as the development of technology and its influence on sports results (Castonguay, 2008; Kurtzman, 2005; Mullin et al., 2007; Olivier, 2006), up to issues such as the social commitment of society in the city area (Miragaia et al., 2017) and the ability to seize market opportunities (Shane and Eckhardt, 2003; Shane and Venkataraman, 2000).

The analysis was developed using a research protocol based on Yin's prescriptions (Yin, 2014) to validate our construction, internal, and external validity results. Following our research protocol, we defined interviews and their questions and length. Thus, our case studies analysis was developed through semi-structured interviews with the female entrepreneur of the team. Our data were principally gathered in three months. The interviews averaged were of 200 minutes in length. They were tape-recorded and then transcribed.

The questions supporting the analysis have been extensively explored. Therefore, the research focused on interviews on the following topics: i) personal values and characteristics of female entrepreneurs; ii) entrepreneurial mindset (EM), entrepreneurial culture (EC) and decision-making processes (DMP); iii) tools that encourage innovation, proactiveness, risk-taking, growth opportunities, growth ability and growth orientation, used by a female entrepreneur in times of crisis to overcome them.

3.2 Data analysis

To analyse the data, we used the Ratten (2011) theory and Ahonen (2019) theory to understand the phenomenon of Virtus Cassino sport organization entrepreneurial growth, the characteristics, within the same basketball club, of sports-based entrepreneurship in terms of innovation, proactiveness and risk-taking and, finally, how these tools have been helpful for top management in overcoming the phases of crisis experienced.

The first framework identifies sport-based entrepreneurship as helpful in understanding sport management. The contribution of Ratten (2011) is to illustrate the different aspects of entrepreneurship that imply proactive, innovative and risk-taking behaviours in the business context.

In the second framework, however, the goal is to understand the entrepreneurial growth of sports clubs through the analysis and identification of four managerial attitudes: i) growth orientation, ii) growth capacity, iii) ability to gain competitive advantages and iv) ability to seek market opportunities.

However, it is possible to state that the second framework (Ahonen, 2019) is an evolution linked to the first framework (Ratten, 2011), since the managerial practices aimed at innovation, proactiveness and risk-taking, theorized by Ratten (2011), fall within growth-oriented management practices proposed by Ahonen (2019) (Table I). Nevertheless, Ahonen (2019) considers the company's growth orientation as the last stage of the activities offered by company management, as they are preceded by growth opportunities for companies and by the growth ability in knowing how to exploit them by the administration.

Table I: Topics characterizing the research framework

		Growth Orientation		
		Innovation	**Proactiveness**	**Risk-Taking**
Growth Opportunities	Growth Ability	Social Network	Fan's Loyalty	Decision flexibility
		Scouting	Sponsor's Loyalty	Hearing of the right interlocutors
		Interview	Sponsor Day	Sports Results
		Fan engagement	Service's Popular prices	Stakeholder Satisfaction
		App mobile	Exploiting popularity of	Sustainability

			players
		Brand awareness	Media Presence
		Virtual sports experiences	Fun Experience during matches
		Sports equipment innovation	Youth Sector
		Technologies at referee's service	Good relations with insiders
		Sport Bets	Merchandising
			TV rights

These frameworks were chosen because they focused specifically on sports clubs and allowed for an in-depth analysis of the case study. We have tried to understand how the factors studied by Ratten (2011) and Ahonen (2019) were developed in the reality of Virtus Cassino. To this, we added the analysis of the crisis period, trying to understand which attitudes and choices were decisive in overcoming the particular moment of difficulty.

The primary findings of the interviews were discussed with the female entrepreneur to validate the research findings (Yin, 2014). Finally, a chain of evidence matrix was used to ensure reliability (Yin, 2014), providing a consistent interview structure and establishing an archival record. The following section presents the results of the analysis and the discussion.

4 Results

The following section presents the case study analyses using Ahonen (2019) and Ratten theory (2011), answering our research question:

> *"RQ: How does the female entrepreneur face crisis management in sport-based entrepreneurship?"*

4.1 Growth Ability

Growth ability comprises the company's resources, the working environment and the specific features characterizing the industry in which the company under study operates. In this regard, the female entrepreneur of Virtus Cassino underlined:

In the sports world, two components are fundamental for success: the financial resources, the right managers able to handle the club and the right athletes to achieve a sporting result set by the managers. These factors are attributable to human capital and financial capital.

The literature on entrepreneurship underlines the roles of human and financial capital (Gilbert et al., 2006) as key to success. The financial resources for this team sport are sponsorships and game event income. Presenting itself as a niche sport, the nature of this business presents an additional financial challenge: operating costs are set, but revenues differ throughout the season based on team success:

I have always made the management decisions of the club. In a context such as the sporting one, the difficulties to be faced are various but always attributable to the lack of satisfactory sporting results or below those expected compared to the investment made by the club.

The activities carried out by the clubs to bring sports results above the expected levels of satisfaction are:

The main actions were purchasing and selling athletes, perhaps by hiring athletes of experience and apparent fame rather than young promises that could have delivered better. Focusing on a coach with more experience and a cultural background made up of many years among professionals has meant more significant serenity and confidence in the players, who were put in a position to perform better on the field from the point of view of individual performances.

An industry-specific issue concerning human capital is the uncertainty of the outcome concerning the recruitment of athletes and managers into the labor market. Donatella Formisano, on the topic, says that:

Coaches and athletes are critical parts of the success of sports clubs. They positively and negatively influence creativity, such as the managers' ideas.

Expensive players, such as coaches who do not reflect the club's right game ideas, could be unsuitable investments in the medium-long term. Despite the risks and uncertainties, numerous studies have underlined the paramount importance of team building: a successful team requires the best players and expert coaches.

Human capital issues that impact club performance and growth on and off the pitch include the right people in all positions, players, technical staff and administration. Successful recruitment and a competent board of directors comprised of executives dedicated to the cause for which they are employed are

the main functions of corporate (Poufelt, 2007) and entrepreneurial growth, resulting in management with positive effects oriented towards the development of the club.

Since broadcast rights do not generate significant revenues, sponsors, customers, and stakeholders are essential for creating value in the clubs' corporate networks and their generated revenue structure. Social entrepreneurship issues, such as corporate social responsibility, are essential for attracting sports sponsorship (Miragaia et al., 2017):

> *The social commitment and the activities carried out by the company to involve entrepreneurs rooted in the territory determine a greater probability for the company to achieve the expected results. However, almost all the investments made in the club's structure come from my family's money. Relying on sponsors is unfortunately unsafe, as it inappropriately links the economic destiny of the individual companies' business to that of the sports club. The goal would be to grow our box office sales and revenue from paying customers and season ticket holders. However, this is inextricably linked to the sporting results achieved by the club.*

The last aspects considered relevant in managing a club, especially in times of crisis, are technological innovations (Potts and Ratten, 2016), such as social networks, local media and the press, the local community and the involvement of fans (Ratten, 2018; Woratschek et al. 2014):

> *Creating value for stakeholders becomes an activity of primary importance for the company. They start with the fans, which must be able to enjoy the results achieved, passing through the entrepreneurs, who must be satisfied with the visibility obtained by being close to our brand and ending with the spectators at the races, who must be able to appreciate the splendid competitive spectacle that the match offers.*

4.2 Growth Opportunities

The interviewee stated that the development of her club started from the recognition of the business opportunities in the sports industry in which she operates:

> *In the world of sports, knowing how to seize the opportunities that the "sporting reality" offers you is of fundamental importance. This component*

becomes fundamental, especially if combined with high culture and capacity to detect advantageous situations, such as the purchase of athletes, partnerships with new entrepreneurs, and the use of new technologies capable of exporting the corporate sports product, without forgetting the satisfaction of the various stakeholder's interests.

Opportunities are essential for business development (Shane and Venkataraman, 2000; Shane and Eckhardt, 2003). Opportunities such as using the sports arena for events other than those characterizing the company's core business can be valuable business strategies for approaching new entrepreneurs and new sponsorships.

However, systematic errors in the selection of technical and sports personnel can significantly limit the development of these activities, especially in times of crisis (Barringer et al., 2012; Carter and Jones-Evans, 2012; Greiner, 1989; Smith and Westerbeck, 2007):

The purchase and choice of coaches and athletes in a sports club, especially basketball, are fundamental. A possible mistake involves a considerable loss for society, considering that a roster is not composed like soccer by 20/30 elements but by 10/12 athletes. The club, subsequently, to remedy it, must draw on new resources, which might be helpful in infrastructure or otherwise, to replace the athlete not deemed able to meet the objectives that the team needs to achieve. However, they are not the only factors to consider. An opportunity is to undertake new collaborations with entrepreneurs not known before, take advantage of the corporate brand in recent advertising campaigns not launched early, and provide a unique service to fans able to entice them more to come to see the matches. An additional advantage would be making the club's infrastructure available to external companies to generate a chance for money it would never have collected.

4.3 Growth Orientation: Innovation, Proactiveness, Risk-taking

Very often, entrepreneurial growth is strongly connected to the entrepreneurial orientation of owners and managers (Ahonen, 2019). Entrepreneurial behavior at the firm level is closely related to the club's economic success and growth orientation (Covin et al., 2006; Covin and Slevin, 1991). What was previously stated in the literature, however, is not always verified:

Expectations do not always match results. The manager's responsibilities for decisions that do not satisfy a specific future objective are many, but sporting results do not depend only on his work. The manager tries to achieve a goal with the resources he has at his disposal, sometimes taking risks, sometimes making choices that turn out to be successful, and sometimes making mistakes, as is customary. Responsibilities must be distributed among the stakeholders. The economic support of the territory and local entrepreneurs are highly determining factors in sporting results.

Companies with entrepreneurs willing to take high risks to pursue success are leaders of innovation, proactiveness and risk-taking about the opportunities they are eager to seize (Ciletti, 2012; Ratten, 2011; 2012):

I consider myself the centrepiece of club decisions. My figure, for better or worse, has always been the one that determined the club's fortune or bad luck. From the promotion from the D series to the A2 series, passing through the missed wins leagues of the 2015-16 and 2016-17 biennium and ending with the relegation from the A2 series, every action and behavior have been determinant.

As a sports club, we have grown exponentially over the years, and, I repeat, much of the credit has undoubtedly been mine and my family, which I have involved in this adventure.

However, in most cases of investments in niche sports, the primary source of income of sports entrepreneurs is not represented by the company itself but by the personal business assets owned. The only motivation that drives them to invest in sports is to provide a social contribution to the community (Gallagher et al., 2012):

Sport is pure and only passion. I have only invested in my company and never enjoyed any economic benefits.

However, it has been highlighted in the literature that the interest of communities in the activity of the sports club is a decisive parameter in terms of investment and planning for clubs (Ahonen, 2019):

The greater the interest of the territory in your activity, the more proportional the passion you put into what you propose. Creating involvement is one of the most important stimuli that lead you to invest more than to achieve a more ambitious goal as a sports club.

In times of crisis, therefore, innovation, proactiveness, and risk-taking represent the only activities that the entrepreneur can implement to pursue new successful

strategies (Ratten, 2011): the exploitation of 4.0 technologies (Castonguay, 2008; Olivier, 2006), policies aimed at the development of sports tourism (Kurtzman, 2005), partnerships with fashion brands and technical-sports production (Mullin et al., 2007), social participation on virtual realities (Mullin et al., 2007):

> *In today's reality, the tools provided to sports clubs are essential for achieving satisfactory sports results and overcoming intense moments of crisis. Technology has allowed us, through partnerships with suppliers of automatic and intelligent cameras on the training pitch, to improve the sports performance of our athletes and to predict their chances of getting injured, but also not to lose potential audiences and investors in times of crisis that we had to face due to the disappointing sporting results achieved. Social networks and good marketing campaigns have allowed us to retain our customers and fan base. Today they have allowed us to get up again, always able to count on solid partnerships in the area.*

5 Discussion and conclusions

This paper presents a single case study approach (Berg, 2007; Yin, 2014), analyzing the theories of Ratten (2011) and Ahonen (2019) to understand the impact of female entrepreneurs' characteristics and values on the strategic entrepreneurial decision-making and the results of a sports club in times of crisis. The intention was to answer the research question: "How does the female entrepreneur face crisis management in sport-based entrepreneurship?" using the analysis of a charismatic and thriving female entrepreneur, Donatella Formisano, president of the Virtus Cassino club, a basketball club playing in the third Italian national championship of Serie B. In the men's national basketball championships, out of 108 teams, Virtus Cassino is the second club, in addition to Germani Brescia, an A1 team, to have of president a woman.

Our results provide both theoretical and practical contributions to the literature on female entrepreneurship and decision-making, in times of crisis, by women entrepreneurs (Kogut and Mejri, 2022). The present study focuses on examining the relationship between the values and personal characteristics of the female entrepreneur and her ability to make strategic decisions in times of crisis with the prospect of obtaining satisfactory results from a sporting and business results point of view through growth ability, growth opportunities, growth orientation, innovation, proactiveness and risk-taking (Ahonen, 2019; Ratten, 2011). These

interconnected concepts play a crucial role in achieving growth and success. From the results collected, we assume that the values and personal characteristics of the female entrepreneur positively influence the company's decision-making process.

Crisis management is crucial for achieving growth and success. A crisis management plan should focus on growth ability, growth opportunities, growth orientation, innovation, proactiveness, risk-taking, and crisis management can help organizations achieve long-term success and reach their full potential.

The set of personal values and essential characteristics of the organization created by Donatella Formisano confirm how these managerial and strategic activities are vitally important for the company's success and have been fundamental for the sports club to overcome the crisis object of analysis. Leaders should be able to remain calm, communicate clearly and effectively, make quick decisions, and take responsibility for the situation. They should also be able to support and guide their team members and ensure that everyone is working towards the same goals. The leadership of the female entrepreneur in the society under study was fundamental for overcoming the crisis and, therefore, could serve as a model for replicable stereotypes in other similar organizations.

Therefore, the research results are relevant for sports clubs, managers, entrepreneurs and researchers. For sports clubs, managers and entrepreneurs, the results suggest that even organizations led by women are ready to overcome situations of managerial crisis brilliantly and, thanks to their excellent leadership, can actively contribute to outstanding company value even in a context such as sports. The findings, for the researchers, broaden the research scope of women's strategic decision-making and their approach to the underperforming business crisis.

The study's limitations derive from the analysis of a single case study. Future research could be directed towards comparing values, characteristics and approaches to the crisis of other women entrepreneurs in Italy and other countries in sporting contexts but not only to extend the existing literature further.

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Does 'Doing Good' Really Imply 'Doing Well'? The Effect of *Organisational Phronesis* on Corporate Social Responsibility Performance and Learning Strategy

Sophia Mayrhofer

Vienna University of Economics and Business
Austria

Florian Kragulj*

Vienna University of Economics and Business
Austria

Raysa G. Rocha

NECE Research Center in Business Sciences
Beira Interior University
Portugal

Marcia J. d'Angelo

FUCAPE Business School
Brazil

* *Corresponding author*

Abstract

This paper empirically demonstrates that an organisation's ability to exercise phronesis shapes its learning strategy and promotes socially responsible practices. It highlights the implications of organisational phronesis for enhancing an organisation's performance and contributing to the larger societal good.

This study employs a quantitative approach to investigate the relationship between organisational phronesis, learning strategy, and corporate social responsibility. The empirical analysis was conducted using multiple regression model, by the software STATA, which allows for robust and reliable regression modelling.

The empirical findings of this study demonstrate a significant and positive association between organisational phronesis and both the learning strategy and corporate social responsibility. The multiple regression analysis reveals that higher levels of phronesis within an organisation are associated with a more effective and adaptive learning strategy. Additionally, the results indicate that organisational phronesis is positively linked to corporate social responsibility, reflecting greater commitment to ethical and sustainable

practises that benefit society and the environment. These findings provide novel insights into the role of phronesis in fostering organisational learning and responsible behaviour, highlighting its potential to contribute to long-term organisational success and societal well-being.

Keywords – Practical wisdom, Phronesis, Learning strategy, Corporate Social Responsibility

Paper type – Academic Research Paper

1 Introduction

Current societal challenges such as social injustice, political instability, and climate change require organizations to balance social, ecological, and economic objectives (Rocha & Pinheiro, 2021, p. 69). In response to this need, an increasing number of knowledge management scholars are turning to the ancient *phronesis*, which dates back to Aristotle and emphasizes the practical wisdom necessary for ethical decision-making (Bierly et al., 2000; Nonaka & Toyama, 2007; Rowley & Gibbs, 2008; Rocha & Pinheiro, 2021). By incorporating it, organizations can better navigate the complex and dynamic challenges of today's world.

According to Aristotle (2009/350 B.C.E. - III, 7 1115b19), phronesis is "doing the right thing from the right motive, in the right way and at the right time". Phronesis, also known as prudence, is excellence of character and intellectual excellence; it is "a reasoned and true state of capacity to act with regard to human goods" (Aristotle, 2009: 106 – VI.5, 1140b, 20-21). So, one can see that phronesis serves practical purposes (Nonaka & Takeuchi, 2019, p. 6). Phronesis is action-oriented knowledge that strives for the common good (Nonaka & Takeuchi, 2019, p. 59). Rowley (2006, p.1250) stated that it is "the capacity to put into action the most appropriate behaviour, taking into account what is known (knowledge) and what does the most good (ethical and societal considerations)". As a distinct type of knowledge, it can help individuals, organisations, and societies to understand and respond to the moral expectations placed on them by various stakeholders (Rowley & Gibbs, 2008, p. 357), thereby serving the sustainability agenda.

Considering this increasing need for organisations to balance social, ecological, and economic objectives while navigating complex societal challenges, this study aims to examine the relationship between organisational phronesis, learning strategy, and social responsibility performance.+ By investigating this relationship, this research contributes to the theoretical understanding of how phronesis can enhance an organization's ability to navigate complex societal challenges while

still achieving economic goals. The findings provide practical insights into how organizations can cultivate phronesis as a key driver of sustainable business practices, benefiting not only the organizations themselves but also the wider society.

2 Theoretical Background

In this section, we briefly introduce the core concepts of this research, i.e., organisational phronesis, learning strategy, and corporate responsibility, in order to hypothesize about their interrelationships.

2.1 Organisational Phronesis

At the individual level, phronesis is a construct brought about by Aristotle that concerns the correct application of the right means to achieve good outcome (Rocha & Pinheiro, 2021, p.2). It motivates individuals to think deeply about the "good" and what is necessary in order to lead a good life (Bierly et al., 2000, p.603). Since the perceived "good" should be realized through means appropriate to the situation, phronesis emphasizes practices in specific contexts (Nonaka & Toyama, 2007, p.378). In this context, phronesis does not only help individuals to reach the "good" for themselves, but to judge what goodness is for the whole in general (Nonaka & Toyama, 2007, p.380).

In addition, according to Nonaka and Takeuchi phronesis can be interpreted as "experiential knowledge that enables us to make prudent judgements in timely fashion and to take actions guided by values, principles and morals" (Nonaka & Takeuchi, 2021, p.2). Phronesis is based on knowledge, reasoning, and action (Rocha & Pinheiro, 2021, p.3). Especially a person's knowledge and reasoning depend on their life experience (Rocha & Pinheiro, 2021, p.76). So, phronesis has a strong focus on ethical and social considerations guided by a person's experience.

At the organisational level, "a practically wise organization is both a virtuous and a learning organization" (Rowley & Gibbs, 2008, p.367), deeply shaped by experiential development. Phronesis enables organisations to survive successfully and do good for society (Rocha & Pinheiro, 2021, p.68). Thereby, the organisation understands and acts on the complexity within an organisation (Rowley & Gibbs, 2008, p.365). Planet earth is colourful and multi-faced, it exposes the imperfections of humanity (Nonaka & Takeuchi, 2021, p.6). Hence, a wise

organisation should include an understanding of the interdependence and complexity of the relationships between all stakeholders of an organisation. Collaboration across boundaries and borders is necessary to cope with the upcoming bigger problems in society (Rowley & Gibbs, 2008, p.365).

2.2 Learning strategy

Organisational learning is vital for strategic management (Bierly et al., 2000, p.595). To make knowledge transfer effective, key organisational factors such as a learning strategy are essential (Baker & Sinkula, 1999, p.84). A learning strategy can be characterized as behaviours and thoughts that a learner engages in. The goal of a particular learning strategy may be to influence the learner's motivation, but it can also affect the way in which the learner selects, acquires, organises, or integrates new knowledge (Ye et al., 2020, p.3). The capability to learn and adapt leads to new knowledge and increases an organisation's performance and long-term success. This is reflected in an organisational learning strategy that can promote organisational change (Kragulj, 2016, p.225).

2.3 Corporate Social Responsibility

Sustainability and responsibility are an essential part of global business operations (Durst, 2021, p.1). Corporate social responsibility (CSR) is a framework that structures responsible handling of corporate power and social commitment. It combines economic, social, and environmental goals (De Witte & Jonker, 2006, p.2).

Carroll presents an overview that shows the evolution of CSR since the 1950s and illustrates that it is difficult to find a general framework of CSR (Turker, 2009, p.413). His studies show four avenues of CSR. Economic responsibility, which sees profit as the main factor in the creation of the company. Legal responsibility which sees complying with law as a prerequisite. Ethical responsibility which focuses on the expectation society has of the company focusing on ethics. Philanthropic responsibility which is desired by the society and is in comparison with other forms of responsibilities not expected and presents organisations' voluntary attitudes to increasing the communities' well-being (Rocha, d'Angelo, 2021, p.2). Over the past few decades, CSR has evolved from a philanthropic to a mandatory attribute (Carroll, 2008). It can be seen as a successful business model

that offers comparative advantage (Kramer & Porter, 2011) and promotes sustainable development (Ye et al., 2020).

Due to rapid changes in the market and in society, companies are increasingly asking themselves questions that directly affect the sustainability of the company regarding the economic, social, and ecological dimension such as whether the company's business model is sustainable or whether new product, service and management innovations are necessary (Kramer & Porter, 2011, p.6). Regarding this, sustainable entrepreneurs are gaining in importance. According to Parrish and Foxon (2009, p.47) sustainable entrepreneurs design their companies with the main intention of making contribution to the quality of the environment and to the social common good, but they can also act as catalysts for a larger transformation. They implement sustainable development into their core business framework and create new products, services, techniques, and organisational modes that immensely reduce environmental effects and consequently increase the quality of people's life (Schaltegger & Wagner, 2011, p.223).

So, CSR is intended to create a new space in which business and society do not represent a contradiction, but in which companies are embedded in their social environment and can only act successfully in this way. This requires entrepreneurial value creation that benefits both the company and society (Porter & Kramer, 2015, p.153). How organisations respond to the challenge of sustainability profoundly ensures their competitiveness and their survival. CSR can be seen as a strategic opportunity that can be seized (Lubin & Esty, 2010, p.43). In this context, it can lead to innovate business practices that have a positive impact on people, planet and profit (Zwetsloot, 2003, p.201).

3 Conceptual Framework and Hypotheses Development

To find out to what extent organisational phronesis has an effect on the learning strategy of an organisation and CSR, we developed the following framework (Figure 1) and hypotheses.

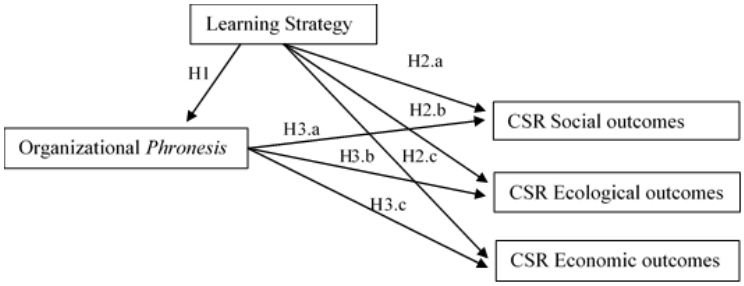

Figure 1: Conceptual Framework.

3.1 The effect of organisational learning strategy on organisational phronesis

Experience and actions are the essence of organisational learning. Phronesis can be seen as new high-quality tacit knowledge that gives organisational members the opportunity to make mindful decisions and take appropriate actions inspired by group values, group culture and shared goals (Erden et al., 2008, p.12). Thereby, organisational culture, values and beliefs of organisational members define the outcome of organisational learning (Rocha & Pinheiro, 2021, p.76). With the integration of phronesis in companies, the practical, subjective, and future-creating aspects of the dynamic process of strategy development and implementation in knowledge-creating companies can be explained (Nonaka & Toyama, 2007, p.378).

In order to guarantee a connection and learning between individuals, a ba, that is a shared context, ought to be created where phronesis is integrated and the knowledge of each individual is shared, utilized and learned (Rocha & Pinheiro, 2021, p.76). These learning-oriented interactions in a shared context are necessary to spread individual phronesis among members of a team and to develop collective phronesis (Klein, 2015, p.155). A shared context gives organisational members the opportunity to be understood and to see beyond their own limited perspectives (Nonaka & Takeuchi, 2011, p. 64). Based on the above discussion, we hypothesize the following:

> *Hypothesis 1. An organisation's learning strategy positively affects organisational phronesis.*

3.2 The effect of the learning strategy on corporate social responsibility

Studies illustrate the relationship between organisational learning and CSR (Valdez-Juárez et al., p.2f; Balasubramanian & Balaji, 2021, p.247). In recent years, academics and practitioners from all fields have found that knowledge can increasingly be considered as one of the key resources for organisations to thrive in the current socio-economic environment (Martínez-Martínez et al., 2022, p.1). Thereby, organisational learning is an instrumental tool in adopting and executing CSR (Ghasemzadeh et al., 2021, p.5).

More and more organisations try to adopt and implement new learning strategies to improve their social responsibility processes (Valdez-Juárez et al., 2019, p.2f). Organisational learning can be seen as a prerequisite for changing the mindsets and motivations of employees, leading to an increase in their commitment to the effectiveness of CSR initiatives (Ghasemzadeh et al., 2021, p.5). A learning organisation is able to build up, develop and pass on knowledge. The behaviour of individual members can be changed to show a new knowledge and understanding (Martínez-Martínez et al., 2022, p.2). Based on that, we can predict the following:

> *Hypothesis 2.a. An organisation's learning strategy positively affects the social outcomes of CSR.*

A learning orientation promotes sustainable innovations, which leads to responsible behaviour in organisations (Valdez-Juárez et al., 2019, p.4). For instance, sustainable innovations such as using electric cars, building zero-emissions buildings, and constructing more trains are being promoted (Banerjee & Duflo, 2020, p.209). In addition, organisational learning strategies lead to environmental knowledge. Environmental knowledge is referred to as the knowledge persons have about themselves and the environment around them (Martínez-Martínez et al., 2022, p.5). An ecological perspective enables people to see how a destructive-creative process works. Destruction in any kind of forms - through disease, flood, wind, or fire - gives spaces in an ecosystem, where small innovation can proceed without disruption from lack of resources (Hurst, 2012, p.762). Furthermore, environmental learning consists of processes that acquire, disseminate, and use knowledge about the natural environment. The processes involve the socialization, externalization, combination, and internalization of knowledge, with the goal of increasing sustainable performance (Martínez-Martínez et al., 2022, p.5). Accordingly, we propose the following:

Hypothesis 2.b. An organisation's learning strategy positively affects the ecological outcomes of CSR.

Furthermore, companies from various industries have found that organisational learning creates new ideas, products, processes, and technologies performance (Martínez-Martínez et al., 2022, p.1). Moreover, in order to obtain a competitive advantage a good organisational learning strategy is essential (Ghasemzadeh et al., 2021, p.1). The better individuals and organisations are at learning, the greater are their opportunities to understand and seize trends in the business environment (Ghasemzadeh et al., 2021, p.5). Especially in a rapidly changing business environment, learning should become an integral part of the daily operations of a company, as they have a positive effect on an organisations' financial performance (Ghasemzadeh et al., 2021, p.1; Torkelli & Durst, 2022, p.4). Based on the above discussion, we can predict the following:

Hypothesis 2.c. An organisation's learning strategy positively affects the financial outcomes of CSR.

3.3 The effect of organisational phronesis on corporate social responsibility

Phronesis is expected to have an impact on CSR. Values and the idea of "doing the right things" are extremely important for CSR (Zwetsloot, 2003, p.201). Phronesis gives organisations the ability to form the business environment and thereby strives for a future combining social, ecological, and economic goals (Rocha et al., 2022, p. 11). As Goede (2010) claims, "the wise organization is a green organization that manages a triple bottom-line: people, planet and profit" (Goede, 2011, p.37).

Phronesis enables organisations to take wise actions which has social well-being as its outcome (Rocha et al., 2022, p.7). It encourages individuals, organisations, and societies to understand and respond to the moral expectations placed on them by various stakeholders (Rowley & Gibbs, 2008, p.357). It can be viewed as a construct that may be one of the pathways to start reconnecting businesses with society (Rocha & Pinheiro, 2021 p.133). Phronesis as knowledge practice extends the social science's agenda as it puts it focus on improving the human condition and making the world a better place to live in (Nonaka & Takeuchi, 2019, p.31).

Organisational scandals, inequality, and climate change scream for improving social well-being (Rocha & Pinheiro, p.2). One great necessity to meet society's

needs is to enhance educational programs, especially business education. Phronesis implemented into business education encourages people to develop a new way of thinking, as they begin to understand that their mental models should go beyond economic importance (Rowley & Gibbs, 2008, p.366; Rocha & Pinheiro, p.74). Especially phronesis encourages people to become part of an open knowledge community driven by a higher purpose (Nonaka & Takeuchi, 2019, p.8). Having a shared purpose that puts commitment to the common good first, helps members of organisations to get united and thus encourages them to accept the common goal or plan, also giving them a reason for action (Rocha & Pinheiro, 2021, p.156). For that, it is important to always bear in mind that phronesis is a necessity as it is "a reasoned and true state of capacity to act with regard to human goods" (Rowley & Gibbs, 2008, p.357). Therefore, we set up the following hypothesis:

> *Hypothesis 3.a. Organisational phronesis positively affects the social outcomes of CSR.*

Furthermore, phronesis strives for an interaction between colleagues, customers, business rivals and the environment and therefore helps to move companies, community, and society into a sustainable direction (Nonaka & Takeuchi, 2019, p.31). The loss of natural resources and the consequences of environmental degradation have become critical issues. Climate change threatens the survival and stability of modern societies (Rosário et al., 2022, p.1). As phronesis is an action-oriented construct, it can be integrated in all dimensions of the Sustainable Development Goals (SDGs) goals, which draw attention to the fact that sustainability should become an imperative for organisations all around the world (Rocha et al., p.5).

An early study by Minna Gillberg already showed how a process of change requires a phronetic search for knowledge in which the ethical dimension manifests itself in the form of sustainability through changed practice and rationality (Gillberg, 1999, p.1). This altered rationality can be described as ecological rationality, in which people's minds have evolved to extract cues for action from the contexts in which they find themselves. This allows fast decisions under pressure of time and conditions of uncertainty. Advocators of ecological rationality are convinced that phronesis ought to be seen as the "gold standard" for rationality. Ecological rationality makes people realize that destruction is very rapid, and that innovation and the creation of growth and wealth take a much longer time (Hurst, 2013, p.762). In particular, exceeding certain temperatures

could trigger abrupt, unpredictable and potentially irreversible changes that have massively disruptive effects on the environment (Klein, 2015, p.1).

In relation to this, the common good can be linked to the natural environmental good, since a healthy environment is a prerequisite for living well: In recent decades, environmental psychologists and other social scientists have discovered links between the natural environment and human well-being (Biedenweg et al., 2017, p.112). Specifically, living in a healthy natural environment has positive effects on an individual's stress level (Ulrich et al., & Zelson, 1991; Irvine et al., 2013), emotional well-being (Bratman et al., 2015) and cognitive performance (Keniger et al., 2013). For reaching the natural environmental good, phronesis is required, as it helps to make organisations realize that thoughtful actions towards sustainability and the environment should happen "here and now" with a clear vision in mind (Lee et al., 2020, p.2; Nonaka & Takeuchi, 2019, p.81). Accordingly, the hypothesis reads as:

> *Hypothesis 3.b. Organisational phronesis positively affects the ecological outcomes of CSR.*

In order to maintain competitive advantage focusing on organisational performance is necessary for any organisation (Rhodes et al., 2008, p.86). According to Porter and Kramer in order to achieve long-term success, shared value is essential as it creates economic value for society by addressing its needs and challenges. Thus, shared value can be viewed as a new path that leads to economic success. It offers an opportunity for a major transformation of entrepreneurial thinking. To recognize this, leaders and managers need to evolve new knowledge (Kramer & Porter, 2011, p.4). Phronesis can be seen as high tacit new knowledge that strives for the common good, but also economic growth (Rocha et al., 2022, p.2). As a practically wise organisation achieves longevity due to a greatly sustainable performance, its outcomes have social, but also economic value, which can be referred to as shared value (Rocha & Pinheiro, 2021, p.10).

In addition, economic value arises from continuous innovation and the best use of resources (Rocha & Pinheiro, 2021, p.10). Phronesis as knowledge practice can also be seen as an approach that fosters continuous open innovation and performance. (Nonaka & Takeuchi, 2019, p. 50). As Bierly et al. claim, it enables organisations to solve problems and to execute tasks that affect the efficiency and effectiveness of an organisation. In particular, organisations are able to choose the most efficient knowledge for a given situation and put it into action

while doing the least harm possible (Rocha & Pinheiro, 2021, p.141). These statements predict the following:

> *Hypothesis 3.c. Organisational phronesis positively affects the economic outcomes of CSR.*

4 Research method

4.1 Data collection

We collected data through an online survey. The sample includes 276 employees in Austria who work in for-profit companies. The role and perception of employees in relation to CSR is crucial, as they can be seen as legitimate stakeholders at the heart of an organisation. They need to be integrated into business activities and practices that lead to organisational change. Therefore, it is necessary to understand how employees perceive their organisation.

4.2 Survey design

The questionnaire of the survey used a five-point Likert scale from Strongly agree (1) to Strongly disagree (5). The survey items were selected based on scales previously validated on organisational phronesis (Rocha et al., 2021), learning strategy (Baker & Sinkula, 1999), and CSR (Balasubramanian & Balaji, 2021). For the latter, we used the following three factors: Employee-Related Sustainability – ERS (i.e., social outcomes), Environmental Management Sustainability – EMS (i.e., ecological outcomes) and Financial Sustainability – FS (i.e., economic outcomes).

4.3 Data analysis

To test the framework, we applied multiple linear regression modelling using STATA software version 17. Regression analysis is a statistical method for studying and modelling the relationship between variables (Montgomery et al., 2021, p.1). It is the most widely used technique for dependency testing and applicable to research questions that involve either prediction or explanation.

Multiple regression analysis is a statistical method within the general linear regression model, analysing the relationship between one dependent and multiple independent variables (Hair et al., p.259f). As our research goal is to

understand the relationship between complex theoretical models, multiple linear regression is suitable.

5 Analysis of the Results

5.1. Sample profile

The sample is largely composed by females between 20 and 39 years old working in the private sector in micro or small organizations. The characteristics of the sample are displayed below (Table 1).

Table 1: Sample profile*

Characteristics	Freq.	%
Gender		
Female	149	59.60
Male	100	40.00
Diverse	1	0.400
Total	250	100.00
Age		
20-29	117	46.80
30-39	65	26.00
40-49	28	11.20
50-59	38	15.20
60-69	2	0.80
Total	250	100.00
Time in the company		
Up to 1 year	74	29.60
1-5 years	92	36.80
5-10 years	40	16.00
10-15 years	20	8.00
15-20 years	14	5.60
More than 20 years	10	4.00
Total	250	100.00
Sector		
Private Sector	174	69.60
Public Sector	76	30.40
Total	250	100.00
Size of the company		
Micro company (< 9 employees)	56	22.40
Small company (< 49 employees)	75	30.00
Medium company (< 249 employees)	38	15.20
Large company (> 249 employees)	81	32.40
Total	250	100.00

* 26 respondents preferred not to disclosure their characterisation.

5.2. Descriptive statistics

The Environmental Management Sustainability (μ = 3.372) and the Financial Sustainability (μ = 3.707) have the lower averages, while Learning Strategy (μ = 3.888) and Organisational Practical Wisdom (μ = 3.827) have the highest averages. Table 2 shows the descriptive of all items.

Table 2. Descriptive statistics of the items

	Variables	Mean (μ)	Minimum	Maximum
Organisational Practical Wisdom	OPW1	3.808	1.000	5.000
	OPW2	3.681	1.000	5.000
	OPW3	3.728	1.000	5.000
	OPW4	3.848	1.000	5.000
	OPW5	3.909	1.000	5.000
	OPW6	4.152	1.000	5.000
	OPW7	3.848	1.000	5.000
	OPW8	3.707	1.000	5.000
	OPW9	4.007	1.000	5.000
	OPW10	3.583	1.000	5.000
	OPW	3.827	1.000	5.000
Learning Strategy	L1	3.736	1.000	5.000
	L2	4.018	1.000	5.000
	L3	3.909	1.000	5.000
	L	3.888	1.000	5.000
Employee-Related Sustainability	ERS18	4.047	1.000	5.000
	ERS19	3.764	1.000	5.000
	ERS20	3.891	1.000	5.000
	ERS21	3.801	1.000	5.000
	ERS22	3.663	1.000	5.000
	ERS	3.833	1.000	5.000
Environmental Management Sustainability	EMS9	3.355	1.000	5.000
	EMS10	2.956	1.000	5.000
	EMS11	3.525	1.000	5.000
	EMS12	3.337	1.000	5.000
	EMS13	3.688	1.000	5.000
	EMS	3.372	1.000	5.000
Financial Sustainability	FS1	3.605	1.000	5.000
	FS2	3.754	1.000	5.000
	FS3	3.667	1.000	5.000
	FS4	3.804	1.000	5.000
	FS	3.707	1.000	5.000

Regarding the correlation coefficients are greater than zero, indicating a positive relationship between the variables (Table 3). The correlation coefficient can assume values between -1 and +1. With a value of 0, the two variables are not linearly related at all; with a value of +1, there is a completely positive linear relationship between the variables considered. A value of 0.8 or above indicates a strongly positive linear correlation, which is the case with our present variables under study (Spearman, 1904).

Table 3: Correlation of the variables.

	OPW	**L**	**ERS**	**EMS**	**FS**
OPW	1.000				
L	0.903	1.000			
ERS	0.936	0.885	1.000		
EMS	0.919	0.853	0.904	1.000	
FS	0.921	0.844	0.853	0.881	1.000

5.3. Regression analysis

Overall, the analysis of the regression indicates that the p-value of the regression model is suitable and significant ($p < 0.001$). It can be read at the top left of Table 4 at Prob > F = 0.0000. The adjusted R-square can take values between 0 and 1. The higher the value is to 1, the better the explanation of the regression equation and thus the better the prediction of the dependent variable (Hair, Black, Babin & Anderson, p.260).

Table 4 reports the results for H1, the value of the adjusted R-squared (Adj-r^2 = 0.9222) achieved here can be regarded as very good and means that the regression can explain 92.22% of the variability of OPW. The coefficient of the variable L is 0.2274. This value states that for every one unit increase in the L, OPW increases by an average of 0.2274. The p-value of the variable OPW is < 0.001. Thus, H1 is supported, meaning the Learning Strategy has a significant impact on OPW.

Table 4: Testing for Organisational Practical Wisdom (H1)

Number of observations	276				
F (2, 273)	1631.14				
Prob > F	0.0000				
Adj R-squared	0.9222				
Root MSE	502.97				
OPW	Coefficient	t-value	p-value	95% conf.	interval
(H1) L	0.2274	6.96	0.000	0.1631	0.2917
_Cons	20.8947	0.66	0.508	-41.1757	82.9652

Table 5 reports the results of H2.a and H3.a. Since the p-value is < 0.001, L and OPW have a significant impact on ERS. OPW and L can explain 88.37% (Adj-r^2 = 0.8837) of ERS variability. Also, for every unit increase in OPW, ERS increases by an average of 0.7484. Likewise, for every unit increase in L, ERS increases by an average of 0.187. Thus, both H2.a and H3.a are supported and OPW has more effect than L in ERS.

Table 5: Testing for Employee-Related Sustainability (H2.a and H3.a)

Number of observations	276				
F (2, 273)	1046.24				
Prob > F	0.0000				
Adj R-squared	0.8837				
Root MSE	618				
ERS	Coefficient	t-value	p-value	95% conf. interval	
(H3.a) OPW	0.7484	15.54	0.000	0.6536	0.8432
(H.2.a) L	0.1871	4.42	0.000	0.1039	0.2705
_Cons	12.9675	0.33	0.738	-63.3174	89.2522

Table 6 reports H.2.b and H3.b. Since the p-value is < 0.001, L and OPW have a significant impact on EMS. OPW and L can explain 84.60% (Adj-r^2 = 0.8460) of ERS variability. Also, for every unit increase in OPW, EMS increases by an average of 0.8556. Likewise, for every unit increase in L, EMS increases by an average of 0.1174. Thus, both H2.a and H3.a are supported and OPW has more effect than L in EMS.

Table 6: Testing for Environmental Management Sustainability (H2.b and H3.b)

Number of observations	276				
F (2, 273)	756.58				
Prob > F	0.0000				
Adj R-squared	0.8460				
Root MSE	751.89				
EMS	Coefficient	t-value	p-value	95% conf. interval	
(H3.b) OPW	0.8556	14.60	0.000	0.7403	0.9710
(H.2.b) L	0.1174	2.28	0.023	0.0160	0.2188
_Cons	32.3421	0.69	0.493	-60.4695	125.1538

Table 7 reports H.2.c and H3.c. Since the p-value is < 0.001 for OPW, it have a significant impact on FS. OPW can explain 84.85% (Adj-r^2 = 0.8485) of FS variability. Also, for every unit increase in OPW, FS increases by an average of

0.9236. Conversely, L has no significant impact on FS (p = 0.243). Thus, only H3.c is supported.

Table 7: Testing for Financial Sustainability (H2.c and H3.c)

Number of observations	276				
F (2, 273)	770.79				
Prob > F	0.0000				
Adj R-squared	0.8485				
Root MSE	750.92				
FS	Coefficient	t-value	p-value	95% conf. interval	
(H3.c) OPW	0.9236	15.78	0.000	0.8084	1.0388
(H.2.c) L	0.0601	1.17	0.243	-0.0411	0.1613
_Cons	10.2208	0.22	0.828	-82.4713	102.9129

Table 8 displays the results of the hypotheses test. In sum, the study found that an organization's learning strategy has a positive impact on OPW. This, in turn, has a positive influence on CSR, including its social, ecological, and economic outcomes. Moreover, an organization's learning strategy has a positive impact on social and ecological outcomes. These findings emphasize the importance of developing a learning-oriented and phronetic culture within organizations to enhance their overall performance and promote responsible and sustainable practices.

Table 8: Results of the Hypotheses test.

Hypotheses	**Results**
H1. An organisation's learning strategy positively affects OPW.	Supported
H2.a. An organisation's learning strategy positively affects the social outcomes of CSR.	Supported
H2.b. An organisation's learning strategy positively affects the ecological outcomes of CSR.	Supported
H2.c. An organisation's learning strategy positively affects the financial outcomes of CSR.	Not Supported
H3.a. OPW positively affects the social outcomes of CSR.	Supported
H3.b. OPW positively affects the ecological outcomes of CSR.	Supported
H3.c. OPW positively affects the financial outcomes of CSR.	Supported

6 Discussion

The literature has established a theoretical link between organisational phronesis and the learning strategy of an organisation, respectively between organisational phronesis and CSR (Nonaka & Toyama, 2007; Erden et al., 2008; Rocha & Pinheiro, 2021; Zwetsloot, 2003; Goede, 2011; Rocha et al., 2022). The empirical findings of our study complement the existing literature (Nonaka & Toyama, 2007; Erden et al., 2008; Rocha & Pinheiro, 2021; Zwetsloot, 2003; Goede, 2011; Nonaka & Takeuchi, 2019; Rocha et al., 2022) by quantitatively confirming the qualitatively related constructs in literature.

The findings strengthen the literature on organisational phronesis, as they illustrate that organisational phronesis has an actual effect on key CSR outcomes. First, the correlation analysis confirmed that organizational phronesis, organisation's learning strategy and CSR are highly correlated. Moreover, the outcomes also confirm that higher levels of organisational learning strategy positively influence organisational phronesis, and it positively impacts the social, ecological and economic dimension of CSR. Therefore, phronesis serves as an ethical resource to help organisations to act responsibly and sustainably, benefitting society and the environment (Rocha et al., 2022, p.7). Conversely, the learning strategy impacts only the social and ecological CSR dimensions.

The results of our study demonstrate that companies should develop future-oriented strategies to achieve the common good for organisations, society, and the environment (Nonaka & Takeuchi, 2021). It can be seen as an important facilitating mechanism for an organisation's learning strategy and social responsibility performance.

6.1. Research Implications

The present research provides valuable implications for both academics and practitioners. Firstly, our findings complement and strengthen the existing literature by providing empirical evidence for the theoretical link between organisational phronesis, organisational learning strategy, and CSR. It confirms that organisational phronesis has a significant impact on key CSR outcomes, and it can be considered as an ethical resource for organisations to act responsibly and sustainably.

Secondly, our study highlights the value of developing future-oriented learning strategies that focus on the common good for organisations, society and the

environment. The outcomes suggest that companies ought to adopt an organisational phronesis culture, which can be fostered by an organisation's learning strategy and can serve as a facilitating mechanism for social responsibility performance.

Thirdly, the research provides insights for practitioners on how to improve their organisations' performance in terms of CSR. The findings suggest that companies should focus on developing their organisational phronesis and learning strategy to achieve better CSR outcomes. By adopting an ethical approach, companies can benefit not only their bottom line but also society and the environment.

7 Conclusions

This paper offers first empirical insights on how organisational phronesis supports the social, ecological, and economic dimensions of CSR. The implementation of phronesis into practice fits into the current debate about the common good, as it focuses on the well-being of people and the planet that is essential for long-term sustainability.

This research paper offers initial clarity about the connection between organisational phronesis, the learning strategy of an organisation and CSR. However, regarding limitations, the sample only includes people who work in for-profit companies in Austria. So, culturally specific effects were not considered. Hence, we propose that the relationship between these constructs should be analysed in several countries around the globe and compared. Moreover, it would be valuable to apply mixed quantitative research methods in the future that confirm the relationship of the three constructs. Additionally, future research can investigate the moderating effects of contextual factors such as industry type, company size, and national culture on the relationship between organisational phronesis, organisational learning strategy and CSR.

Since this research empirically established the relationship between organisational phronesis, an organisation’s learning strategy and CSR, further research may explore the characteristics and dimensions of a practically wise workplace. In addition, future research should be conducted on how a phronetic-based culture within an organisation can be established and maintained through CSR practices. Regarding entrepreneurship, it would be interesting to find out how phronesis can help to influence the development of sustainable entrepreneurs whose main intention is to contribute to the quality of the

environment and social well-being. Furthermore, the connection between these constructs and organisational spirituality should also be addressed in future research.

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Developing Sustainable Smart Cities: A Framework for Analysing the Role of Enablers and Barriers Related to KM strategies

Nina Helander*

Faculty of Management and Business
Tampere University
Korkeakoulunkatu 7
33720 Tampere, Finland

Krishna Venkitachalam

College of Business Administration (CBA)
Ajman University, Ajman
UAE

* *Corresponding author*

Abstract

This paper is a work-in-progress study that focus on the role of KM strategies in the context of sustainable smart cities. Drawing on the previous literature on smart cities and KM strategy concepts, the aim of this paper is to propose a conceptual model to examine the enablers and barriers of KM strategies of codification and personalisation for enhancing sustainable development in smart cities context. The proposed research model will be empirically applied in future study with four qualitative smart city case studies from Finland. The current study's theoretical contribution is to advance the smart city discussion by bringing in KM strategy perspectives to enhance sustainable development among cities.

Keywords – Knowledge Management, Sustainability, Smart Cities, Conceptual framework, KM strategies

Paper type – Academic Research Paper

1 Introduction

In the modern knowledge economy, the role of cities involves various centrally important economic and societal service missions, like provision of educational, social and healthcare services; development of urban infrastructure; support for industries and ecosystem of innovation and job creation; and enhancement of local and regional business networks. Besides these central service missions, there are increasing responsibilities of cities to address the impact of uncertain weather patterns, climate change and solve contemporary economic and environmental challenges. In general, the critical purpose and function of cities is to achieve Sustainable Development Goals (SDGs) that have gained importance and relevance in the mindset of individual nations' citizens, policy makers and communities. (Blasi et al., 2022; Trindade et al., 2017)

The strong demand for accountability has increased the impact of cities as central decision-makers and responsible actors in enhancing sustainability. Both in academic and practice-oriented literature, the concept of designing and building smart cities are argued as one way to offer solutions for contemporary sustainability challenges (Neirotti et al., 2014). De Jong et al. (2015) have proposed that smart cities should develop strategic initiatives that aims to create better environmental, social and economic conditions. According to the European Commission (2014, p. 6) smart city is a "place where traditional networks and services are made efficient using digital and telecommunication technologies, for the benefit of inhabitants and businesses". This kind of definition highlights the emphasis on technology and digitalisation in smart cities. However, smart cities are not only technology-oriented places but also need to be understood as strategically distinctive knowledge hubs serving unique mix of value and delivering better future for its citizens and organizations.

According to Israilidis et al. (2021), most studies on smart cities are focused more on the technical and hard aspects (Baccarne et al., 2014; Bakici et al., 2013; Caragliu et al., 2011; Chourabi et al., 2012), leaving room for research that focuses more on the softer side of smart cities. Focusing on the softer side of human and digital elements of strategically managing knowledge, related concepts of creation, transfer, use and application can be considered as integral knowledge processes for the development of sustainable smart cities.

Chong et al (2011) argued that the implementation of KM can be a more demanding undertaking for public sector organizations, such as smart cities,

because of their bureaucratic and political attributes when compared to private sector organisations. They also highlight that effective implementation of KM may help provide stability to organisations and found that an integrated KM strategy enablers of codification and sharing of knowledge as antecedents of organizational performance.

Riege and Lindsay (2006) have suggested the importance to identify stakeholders from multiple perspectives and to create more strategically driven stakeholder policy with more efficient use of resources and increased transfer of knowledge. For instance, efficient ways of creation and use of organisational knowledge resources can be tied to the codification KM strategy, whereas its effectiveness of transfer and application can be linked to the personalisation KM strategy (Venkitachalam and Willmott, 2016) for sustainable development of smart cities. Riege and Lindsay (2006) also suggest the need for empirical based qualitative research to examine policy issues based on KM in public sector organisations.

Drawing on the previous literature on smart cities, sustainability and KM strategy themes, we propose a conceptual model to examine the enablers and barriers of KM strategies of codification and personalisation (or socialisation) for enhancing sustainable development in smart cities context. The proposed research model will be empirically applied in future study with four qualitative smart city case studies from Finland. The current study's theoretical contribution is to advance the smart city discussion by bringing in KM strategy perspective to enhance sustainable development among cities.

To build this kind of research model for further empirical studies, we firstly present the typical knowledge barriers based on the seminal work of Riege (2005) and then discuss the premises of KM strategies. As Riege (2005) has stated, the different knowledge barriers need different kinds of strategies to solve them. Building on these discussions from the viewpoint of the special characteristics of smart cities as the context of our study, we propose the research model as the main result of this paper.

2 Knowledge barriers in sustainability

A factor that disturbs the transmission of knowledge from source to recipient could be argued as a knowledge sharing barrier (Szulanski, 2003). With a view to improve the existing practices regarding knowledge sharing and the identifying

the possible bottle-necks, Riege (2005) presents a categorization of knowledge sharing barriers based on substantial literature review. Riege's (2005) categorization divides knowledge barriers into three categories, which all are interrelated. These categories are namely individual, organisational and technological. In overall these categories include over 30 specific barriers, for example individual category includes barriers such as personal attributes, experience and competence, organisational category includes barriers such as cultural issues, lack of leadership and time as resource, and finally, technological category includes the barriers like unrealistic expectations and lack of technical support. Riege (2005) points out that strategies and practices to overcome the knowledge barriers vary greatly depending on the organisation's attributes. The situation can be even more complex in the smart city context, as they can be regarded as a network of multiple organizational and individual actors, which further challenges the effective knowledge sharing.

When we consider smart city as a nexus of different kinds of actors, i.e. as a complex network organization, the work of Capaldo (2014) offers fruitful viewpoints for knowledge sharing between network organizations. The first viewpoint is knowledge sharing in terms of context specific knowledge, such as environmental knowledge. This kind of knowledge sharing is mostly done between network's key actors and in a very informal way. This kind of personalised codified knowledge deals e.g. sustainability measures in a smart city context. Second viewpoint deals specifically with knowledge transfer. This is mostly related to expert-specific know-how that aims to solve a certain problem at hand. Thus, this viewpoint relates to most acute issues in the smart city context. COVID-19 pandemics and the knowledge transfer needs are a good example of this kind of important issue that requires effective knowledge sharing among the city actors.

Third viewpoint of Capaldo's (2014) study is the in-house knowledge production, that namely focuses more on intra-organizational aspects. Lastly, the fourth viewpoint is knowledge co-production. This fourth viewpoint relates especially to personalization strategy of KM. Capaldo (2014) also states that effective knowledge sharing in the network needs personal relationships, functional macro culture, trust and reciprocity. In other words, these act as knowledge enablers in a networked context of multiple actors. Even though Capaldo (2014) has carried out the study in the context of private sector, these viewpoints are applicable also in the context of smart cities. Being a city can be

regarded as a network entity that includes not only the public actors but more and more also the private actors and even the individuals as citizens.

3 KM strategies and sustainable smart cities

Based on Capaldo (2014) conceptualisation of smart city as a web of actors, it is important to recognise the dynamics of technological, environmental and social spheres of life that are changing today. To navigate in this unknown and emergent nature of circumstances, the need for developing a sustainable-based (Martins et al., 2019) KM strategies perspective on smart cities is necessary. In the development of such a perspective on increasingly complex environmental contexts, the relevance of KM strategies of codification and personalisation and associated process and practices can offer a role to build a sustainable (Abbas and Sağsan, 2019) value-chain in smart city development. For the understanding of the management of smart cities as network organisations, pertinent stakeholder groups such as private organisations, local communities/citizens and government institutions need to develop a better grasp of how to strategically manage knowledge (Dragicevic et al., 2019; Grant, 1996) in a sustainable way (Abbas and Sağsan, 2019; Martins et al. 2019).

Despite the changing nature of cities and its environments, talent mobility, remote working and automation have all contributed to various impact and mix in the management of codification and personalisation KM strategies. Consequently, there are benefits in knowledge codification and sharing but also costs in reinvention and wastage of knowledge assets and resources in modern city developments. Similarly, the expansion and growth of AI-driven technologies, big data etc. can impact smart cities with a huge challenge of overwhelming amount of documented and unstructured knowledge in their digital infrastructures (Trevino et al., 2021) going forward.

To tackle this important knowledge overload challenges (or barriers) in the management of smart cities as network entities, the need for sustainable KM strategies becomes essential. Focusing on KM strategies, smart cities need to effectively and efficiently manage the structured and unstructured knowledge through codification and personalization strategies respectively. Extant literature has argued both codification and personalization KM strategies are pursued (Venkitachalam and Willmott, 2016) at the same time to reduce the process risks of reinvention and ineffective use of network-level organisational knowledge.

Additionally, some studies (Venkitachalam and Willmott, 2015) have confirmed that due to constant change in environmental dynamics, executives need to recognize the importance of a balanced and sustained focus on both KM strategies toward realisation of better management of network-based knowledge in the context of smart cities. Otherwise, this kind of network organisation can be faced with enormous wastage of financial, technological and human capital resulting in unproductive and inept knowledge processes such as creation, transfer, use and application.

4 The proposed research model

Based on the above theoretical discussion we propose a research model that takes into account the KM strategies that enhance the achievement of sustainable development goals in smart cities and provides instruments to analyse the key knowledge sharing barriers and enablers (see Figure 1).

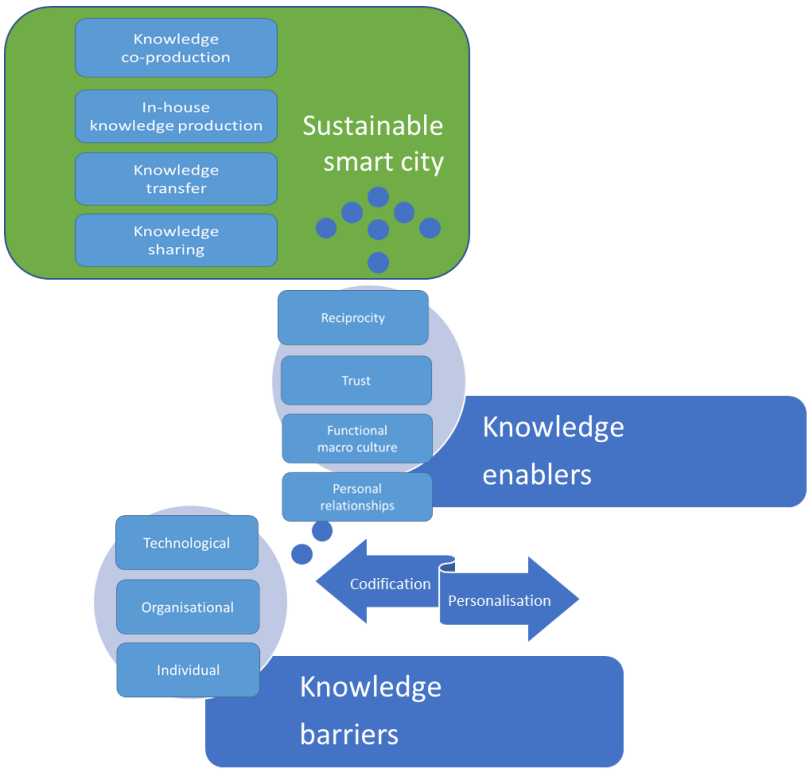

Figure 1. The proposed conceptual research model.

This conceptual model provides the measures to identify the key knowledge barriers based on Riege (2005) main categories of individual, organisational and technological barriers that hinder the efficient knowledge sharing. Each of these three main categories include several specific barriers that can deepen the contextual analysis of the empirical case data related to smart cities. Knowledge enablers based on the work of Capaldo (2014) in which KM has been studied in network setting. Smart cities are indeed a web of varying kinds of actors, thus the proposed (see figure 1) enabling elements of relationships, macro culture, trust and reciprocity offer a functional measure to identify knowledge enablers in smart city context. It is noteworthy that in Riege's (2005) model e.g. lack of trust is mentioned as one of the barriers and in Capaldo's model the existence of trust is logically highlighted as an enabler. Besides of the barriers and enablers the conceptual model includes the KM strategy (Venkitachalam and Willmott, 2016) identification as one of the important phases in the analysis. The model should enhance the analysis of the relationship between the main KM strategy and the key barriers and enablers. This is, however, to be tested in the next phases of this research, the empirical case study of four smart cities aiming towards sustainability.

5 Discussion and conclusions

This paper has proposed a conceptual model to examine the enablers and barriers of KM strategies of codification and personalisation for enhancing sustainable development in smart cities context. The proposed model builds on the seminal works of Riege (2005) on knowledge sharing barriers, Capaldo (2014) on knowledge management in networked context such as smart cities and Venkitachalam and Willmott (2016) on KM strategies.

The main limitation of this paper is the rather straightforward development of the conceptual model, as it has been built only on three selected studies. However, the three studies are all comprehensive in their specific field and they offer multiple and relevant implications to future empirical studies in sustainable smart city context. Nevertheless, the theoretical bases of the proposed conceptual model could be strengthened by leveraging the amount of background studies.

On the other hand, this conceptual research model can be regarded as an initial conceptual level model, and it can be further developed and tested through future empirical studies that we are going to carry out.

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Executive Confidence and Meaningful Coincidences: How to Cope with Turbulent and Uncertain Contexts

Simona Mormile*

Department of Legal Science
University of Salerno
Via Stazione n. 47, Piano di Sorrento, Italy

Gabriella Piscopo

Department of Business Sciences, Management & Innovation
University of Salerno

Paola Adinolfi

Department of Business Sciences, Management & Innovation
University of Salerno

* *Corresponding author*

Abstract

The aim of this study, which is grounded in decision-making theory, is to explore whether the occurrence of meaningful coincidences can positively influence executive confidence, allowing hospitality industry organizations to cope, if only for short periods, in chaotic and uncertain contexts and settings, such as the COVID-19 pandemic.

Through a qualitative study with 24 interviews, conducted both in person and via Microsoft Teams, this study focuses on Italian hospitality facilities in the Campania Region of southern Italy to explore how executive confidence led by meaningful coincidences can influence managerial decisions.

The results highlight the process through which meaningful coincidences lead to the three different characteristics of executive confidence during a decision-making process – overestimation, overprecision, and overplacement. The insights that emerge suggest a number of positive and beneficial aspects for decision-making in a crisis such as the COVID-19 pandemic.

To the best of the authors' knowledge, this is the first study in the literature aimed at investigating, by means of qualitative methodologies, the positive outcomes of executive confidence in decision-making led by meaningful coincidences during crisis periods in the specific context of the Italian hospitality industry.

Keywords – Executive confidence, Meaningful coincidences, Decision-making, Qualitative study, COVID-19.

Paper type – Academic Research Paper

1 Introduction

Since early 2020, the coronavirus outbreak (COVID-19) has forced many businesses to close, leading to unprecedented disruptions and changes in most industry sectors. Companies have experienced and are still experiencing profound transformations that include the need to redesign of business models, and to rethink governance processes, workforce (see Piscopo *et al.*, 2022, on new working practices adopted in the COVID-19 era), and people skills (Xie *et al.*, 2022). New challenges due to the uncertainty of the context have put managerial decision-making capacity, which is increasingly related to dimensions such as speed and effectiveness, at the center of the debate (Foss, 2020). Thus, the COVID-19 pandemic has placed extraordinary demands on executives. Within this context, managers are called upon to make complex decisions characterized by high levels of ambiguity, in a context where the variables are numerous and, above all, often unknown (Craven *et al.*, 2020). Therefore, there is an urgent need to increasingly implement resilient and dynamic leadership in the business context (Meyer *et al.*, 2022).

Drawing on Heavey and colleagues (2022), this study focuses on executive confidence – that is, an executive's generalized or domain-specific belief in his or her capability to complete tasks, influence events, and/or achieve outcomes; the focus on executive confidence helps us to understand how this variable can be effective in managing decision-making in periods of crisis. We also focus on self-confidence because it represents a widespread trait among managers and is often considered a necessity for holding top positions (Banerjee *et al.*, 2014). Studies on confidence have mainly explored its multifaceted nature (e.g., Moore and Healy, 2008; Moore and Schatz, 2017; Stajkovic, 2006), focusing on overconfidence rather than executive confidence in general and not distinguishing confidence from related constructs. Moreover, other studies on executive confidence have mainly explored its negative effects on organizational performance (Audia *et al.*, 2000; Bloomfield *et al.*, 1999), stating that overconfident managers deviate from the rational model of decision-making by adopting a narrow framing (Bailey *et al.,*

2011). Nevertheless, recently, some studies have defined a good side of executive confidence in contrast to negative ones (Aktas *et al*., 2019; Banerjee *et al.,* 2014, Chen *et al*., 2018).

Moreover, in recent years, the influence of emotions on cognition (Lazarus, 2006; Lerner and Keltner, 2000; Lerner *et al*., 2013) and luck (Liu and De Rond, 2016; Denrell *et al*., 2019; Stenholm and Jiang, 2019), considered as irrational variables (Sripada and Stich, 2004), has received much attention from researchers and practitioners. Among the recent advancements made for understanding irrational behavior in management research and practice, meaningful coincidences represent a phenomenon that has gained academic and practical relevance in the past 60 years (Durant, 2002; Hocoy, 2012) and that has never been investigated in decision-making theories in management. This concept was introduced by analytical psychologist and psychiatrist Carl Jung (1952) to describe circumstances that appear meaningfully related yet lack a causal connection. Specifically, in contemporary research, meaningful coincidence refers to one's subjective experience that coincidences between events in one's mind and the outside world may be causally unrelated to each other yet have some other unknown connection (Combs and Holland, 1990). These are events that are not intentionally looked for, to which people assign a symbolic meaning and which differ from luck and chance (Cristofaro, 2020).

Responding to calls in the literature (e.g., Heavey *et al*., 2022), this study aims at investigating if executive confidence led by meaningful coincidences can enable organizations to cope, if only for short periods, with chaotic situations and contexts. Indeed, the literature on executive confidence and meaningful coincidences needs further contributions with reference to non-rational decision making to highlight its impact on business organizations (Heavey *et al*., 2022). The occurrence of meaningful coincidences can influence executive confidence and the context in which the manager operates; thus the literature needs further contributions on this topic (Cristofaro, 2020; Heavey *et al*., 2022).

Therefore, the research question guiding this study is as follow: *How does executive confidence led by meaningful coincidences influences management decision-making during turbulent times*? To answer this question, this study aims to investigate whether the occurrence of meaningful coincidences can positively influence executive confidence, allowing hospitality industry organizations to cope, if only for short periods, in chaotic and uncertain contexts and settings, such as the COVID-19 pandemic. Furthermore, this study contributes to the body

of knowledge on decision-making by responding to the demands for qualitative approaches, such as interviews, required to fully understand the impact of irrational forces on management decisions (Cristofaro, 2017). In particular, manager's subordinates of Italian hospitality facilities were interviewed to try to fully investigate the phenomenon and explore perceptions of executives' decision-making in the real work context (Cristofaro and Giardino, 2020). Implications for theory and practice are discussed.

2 Theoretical Framework

Within the decision-making theory (see also Loia, 2022, on the organization of the decision-making system), while some studies on irrational behavior have mainly explored its negative effect on organizational performance (Audia *et al.,* 2000; Bloomfield *et al.,* 1999), others have investigated affective states that determine the success of management decisions (Cristofaro, 2020). Further studies have instead focused on criteria and processes in decision-making that are not based solely on rationality (Cristofaro, 2019), and the personality traits that affect managers' actions (Abatecola and Cristofaro, 2019; Loia *et al.,* 2022). Specifically, the concept of executive confidence has recently gained attention (Heavey *et al.*, 2022).

In the business context, executive confidence has been defined as an executive's generalized or domain-specific conviction in his or her capability to complete tasks, influence events, and/or achieve outcomes (Heavey *et al*., 2022). This definition recognizes that executive confidence beliefs may have different forms (estimation, precision, placement) and purposes (generalized versus domain-specific). Executive confidence is based on individual dispositions and external cues, and it directly affects decision-making processes (Schumacher *et al*., 2020). Indeed, a confident manager is genuinely interested in improving the organization's well-being while simultaneously enhancing its status (Hribar and Yang, 2016). This attitude reveals why a confident leader has a natural propensity and desire to embark on ambitious, massive, and even risky strategic projects, regardless of the risk of failure (Witkower *et al*., 2021).

Notably, three forms of executive confidence were identified by Moore and Healy (2008): overestimation, overprecision, and overplacement. Overestimation is observed when chief executive officers (CEOs) "*generally think they are better than they are in terms of skill and judgment or in gauging the prospects of a successful*

outcome" (Hribar and Yang, 2016, p. 195). Overprecision occurs when managers/leaders exhibit excessive certainty regarding the accuracy of beliefs (Moore and Healy, 2008), and provide probability distributions of future events with narrow confidence intervals (Hackbarth, 2009; Hayward and Fitza, 2017; Hilary *et al.*, 2016; Levi, *et al.*, 2014). Finally, overplacement is a belief that erroneously rates someone as better than others; it occurs when people believe themselves to be better than others or "*better than the average*" (Thaler and Sunstein, 2008).

Executive confidence differs conceptually from other notions like narcissism, core self-evaluations, optimism (Heavey *et al.*, 2022) and self-immanent pride (Bachkirov, 2022). Although narcissism is a powerful personality feature, there is no evidence for believing that narcissists are more confident than others. In contrast, the narcissist's need to constantly reaffirm him- or herself may in fact indicate the absence of an innate confidence (Chatterjee and Pollock, 2017). Likewise, high core self-evaluations appear similar to executive confidence in capturing positive evaluations of competence, but Heavey *et al.* (2022) add that confidence has more varied origins, may be less enduring, and does not necessarily imply high self-worth or emotional stability. Meanwhile, optimism does not focus on the fact that an individual can influence a positive outcome by applying his or her abilities and influence. Instead, it is a more generalized expectation of positive outcomes (Zuckerman, 2001). Lastly, executive confidence differs from the concept of self-immanent pride, which is conceived as a source of destructive managerial anger (Bachkirov, 2022).

Connected to the theme of executive confidence, the influence of irrational forces on managerial decisions has received increasing attention in recent years. Focusing on irrational behavioral, Ariely (2008) states that people are far less rational than standard economic theory assumes and refutes the common assumption that people behave in fundamentally rational ways.

Kahneman (2011) illustrates the two ways in which the human mind works: the primitive and emotional system (System 1) characterized by "fast thinking" and representing the real protagonist of people's decisions, and the rational system (System 2) characterized by "slow thinking" and judgments made with caution and careful analysis. According to this study, System 1 is the most used during people's daily activities; even when people believe they are coldly pursuing their economic interests, they are actually governed by emotions and blinded by cognitive biases (i.e., the systematic errors of judgement people incur when

applying heuristics). Another study on irrational forces asserts that the use of the right levers on a psychological level can positively influence people's choices without their being aware of it. These levers are called "nudges", and their aim is to try to improve people's well-being by guiding their decisions while maintaining freedom of choice. By leveraging cognitive biases, nudges are designed to induce and persuade individuals to change their behavior in a predictable and non-coercive manner (Thaler and Sunstein, 2008).

Among the recent advancements made in understanding the impact of irrational forces in decision-making in management, in recent years some authors (Durant 2002; Hocoy, 2012) have begun investigating the concept of "synchronicity", which was developed by psychologist Carl Jung to describe a perceived meaningful coincidence – that is, the "*surprising concurrence of events, perceived as meaningfully related, with no apparent causal connection*" (Diaconis and Mosteller, 1989, p. 853). These events have the following characteristics: they must provoke an intense emotion in the subject, they must not be linked by a cause-effect relationship, and they must have a symbolic meaning (Hand, 2014). Meaningful coincidences can alter the course of lives (Brown, 1980) and are the basis of many scientific discoveries (Griffiths and Tenenbaum, 2007) and business foundations (Görling and Rehn, 2008), especially since individuals sometimes rely on them to make important decisions (including business ones) (Beitman, 2016; Govier, 2003).

This topic remains underexplored in relation to decision-making in management theories. Thus, the present study focuses on the bright side of executive confidence led by meaningful coincidences for decision-making (Heavey *et al.,* 2022) in the case of the particular historical period that is, COVID-19 pandemic.

In other ways, this work contributes to the literature by increasing our understanding of the positive decision-making theories of executive confidence led by meaningful coincidences in turbulent and uncertain scenarios (Figure 1).

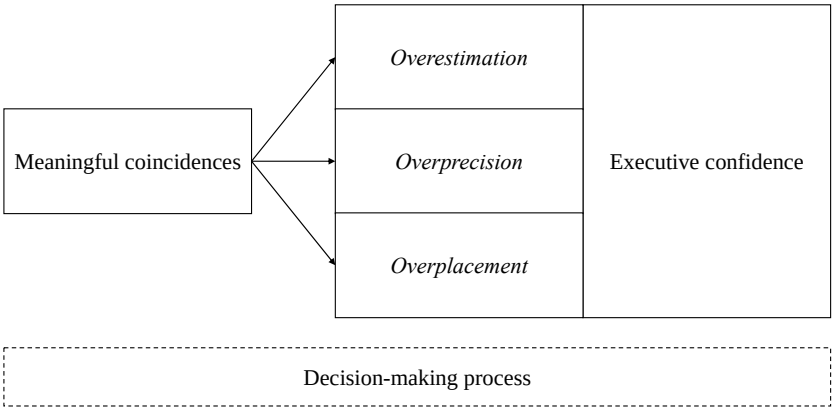

Figure 1

3 Method

3.1 Study context

This study was conducted in Italian hospitality businesses in the Campania Region of southern Italy, notably in the Sorrento Peninsula and the Amalfi Coast. These locations were chosen because they are among the most popular tourist destinations in the world.

One of the most immediate economic effects of the crisis associated with COVID-19 pandemic was the blocking of tourist flows. Indeed, the health emergency had a strongly negative impact on the hospitality industry, resulting in unprecedented consequences (Baum *et al.*, 2020, Kang *et al.,* 2021). Italy was the first European epicenter of the virus and therefore the most vulnerable, most likely due to a geographical, logistical, and meteorological situation that was particularly favorable to the spread of the virus. Therefore, the country had little time to prepare for the pandemic's consequences, increasing subsequent organizational and managerial problems. The Italian tourism industry was profoundly affected by the restrictive measures due to the interpretation of tourism as a volatile and non-essential activity. According to ISTAT data, during the first ten months of 2020, overnight stays decreased by 51.4% compared to the same period of the previous year, with the loss of 207 million tourist visits. Indeed, following the COVID-19 shock, the hospitality sector required a redesign

of its business models, including the need to rethink governance processes and operating modes.

Thus, the COVID-19 pandemic and the lockdown in Italy represent a natural experiment that can help us to analyze how executive confidence led by meaningful coincidences can positively influences managerial decision-making in the specific context of the Italian tourism industry. Indeed, the top management of hospitality facilities has been faced with the need to make decisions during a most unusual and complex period in order to ensure proper performance and survival of their organization.

3.2 Data Collection

To answer our research question, we used a qualitative approach consisting of interviews in hospitality facilities, conducted both in person and via Microsoft Teams. The study was conducted in early 2021, at the end of the first period of reorganization and consolidation of new working practices for the hospitality sector due to the COVID-19. In particular, based on a ranking compiled by a hotel trade association in 2021, 10 hotels with the highest tourist flow and revenue during the pandemic crisis were selected. In order to understand executive confidence, we chose to interview manager's subordinates as the main observers of all organizational choices and dynamics implemented during the pandemic period, avoiding interviewing managers themselves and thus avoiding biased judgments about their own choices. After completing each interview, the research team asked the subordinate to suggest another one involved in the decision-making dynamics of the organization, thereby using the snowball sampling technique to ask questions about how decisions were made during the pandemic period. Data saturation (i.e., repetition of the same themes) was used to calculate the size of the final sample. As a result, 24 manager's subordinates of the 10 hotels were interviewed. All interviews were recorded and then transcribed for further examination within 24 hours of conducting the interview.

To answer our research question, we followed an inductive approach, basing our data analysis on a variety of sources to get a more comprehensive understanding of the phenomena under analysis. In fact, using several sources of information is necessary for qualitative research in order to minimize the effects of any potential biases that could arise when using only one source (Bowen, 2009). Accordingly, we asked interviewees and informed actors to provide us with

archival and written data of any kind (e.g., websites of the hospitality facilities, open-source materials, company brochures, etc.) to give us a thorough grasp of how the organization works and the labor conditions that characterized the company under study.

The study's approach was based on the critical incident technique (Flanagan, 1954) to collect episodes, narratives, and sense-making linked to executive confidence during a turbulent time. This method refers to a set of procedures for collecting direct observations of human behavior in such a way as to facilitate their potential usefulness in solving practical problems and developing broad psychological principles (Flanagan, 1954). Through this method, a sequence of procedures is followed to collect firsthand observations of human behavior to generate new hypotheses. Accordingly, during the interviews, we talked in general to the interviewees to direct the flow of the discussion in the desired direction – that is identifying confidence behaviors of managers led by meaningful coincidences – but we did so without mentioning either of these concepts to avoid influencing the sample. Interviews were conducted by two interviewers as informal conversations and lasted an average of 40 minutes.

3.3 Coding and Analyzing

Following the deductive coding for qualitative analysis (Fereday and Muir-Cochrane, 2006), the study's approach depended on a generic research statement: "We aim at investigating how executive confidence led by meaningful coincidences can positively influence managerial decisions during turbulent and crisis periods." The analysis process involved three phases.

In the first phase, we tried to identify recurrent themes in the interviews based on the respondents' answers. Subsequently, the transcripts from the interviews were uploaded into Dedoose, an online software program for qualitative data analysis. Next, two of the researchers independently reviewed the data, allowing for exploratory data analysis (Saldaña, 2021). Later, Cohen's coefficient κ – a statistic for qualitative categorical analysis that represents the degree of accuracy and reliability – was used to estimate the level of agreement between the coders, following an iterative approach (Locke, 2001). By comparing codes and discussing themes when disagreements emerged, the final consensus reached a value of $\kappa = 0.81$, reflecting high agreement between the raters.

In the second phase, we translated the previously identified concepts and themes into theoretically relevant terms, fitting them into already existing categories. Finally, in the third phase, we integrated the first-order codes and second-order concepts into a data structure, as shown in Figure 2.

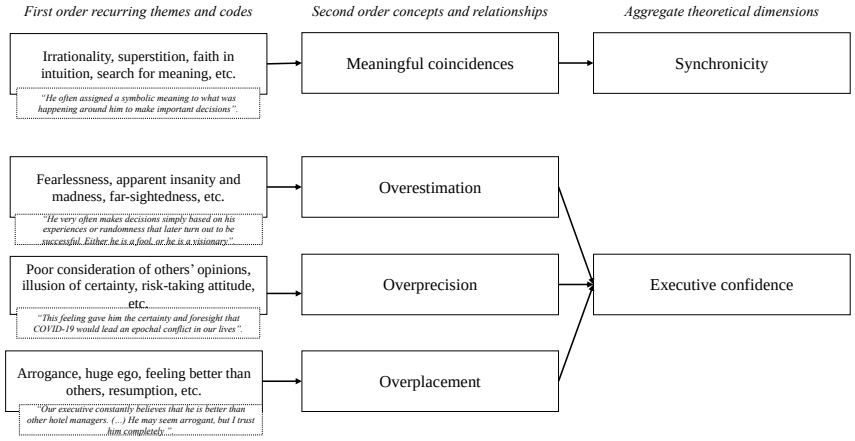

Figure 2

4 Findings

Interestingly, in all of the hospitality facilities in the sample, which were selected on the basis of their excellent tourist flow and revenue during the COVID-19 crisis, certain subordinates' perceptions emerged related to executive confidence and meaningful coincidences.

After collecting and analyzing data, we identified several trends related to the characteristics of executive confidence suggested by Moore and Healy's (2008) classification. In particular, the findings highlight the process through which meaningful coincidences lead to the three different characteristics of executive confidence during a decision-making process – that is, overestimation, overprecision, and overplacement. While these characteristics are typically considered negative (see Moores and Chang, 2009), subordinates' perceptions suggest a number of positive and beneficial aspects for decision-making in a crisis such as the COVID-19 pandemic.

The first recurring aspect in interviews with subordinates concerning managers' decisions in dealing with a turbulent environment is overestimation. This concept

refers to the tendency to overestimate one's own abilities, level of control, or chances of success in seeking to achieve certain outcomes (Drobetz *et al.*, 2020). An interviewee reported: "*the hotel manager is fully aware of his capabilities, and during the COVID-19 emergency, he demonstrated determination and perseverance in his efforts*". In the next passage, one can observe another example of this manager's tendency:

> *Our hotel manager was convinced that it was essential to adopt a high-tech solution that blended sanitation with customer contentment. Would we have the resources to do it? We were a little worried about the outcome of this change, but he believed a lot in this improvement. I am pleased to report that customers really appreciated the implementation of this change.*

Thus, through overestimation in his abilities, this hotel manager has promoted a turnaround that has generated positive outcomes during a turbulent period.

Interviews with manager's subordinates suggest that executives' inclination to overestimate their skills and capacities allowed them to face chaotic and turbulent contexts and that very often this attitude stems from a series of meaningful coincidences experienced by the executive. The following excerpt is an example:

> *The manager of this hotel is very confident. (...) In February 2020, he was supposed to go to a meeting but missed the train by seconds. That train derailed, generating difficulties and problems. This experience caused him to propose to all subordinates not to attend a tourism conference that was scheduled a week after that event. Well, we learned later that there was a COVID-19 contagion at that event, which we avoided by staying home. Some hotels had to close for a few days due to lack of sick staff, while we were all healthy. (...) Either he is a fool, or he is a visionary!*

Consequently, due to his experience, this hotel manager made a decision that produced good results in a very unpredictable environment.

A second theme emerging from the interviews is that of overprecision. This is the most ubiquitous form of overconfidence, referring to a situation wherein executives provide specific point estimates with narrow confidence intervals in their forecasts or predictions of outcomes (Hackbarth, 2009; Hayward and Fitza, 2017).

According to Minson and Mueller (2012), overprecision can make people reluctant to consider others' points of view, listen to suggestions or seek compromise to resolve conflicts. As one interviewee stated, "*our hotel manager doesn't look down his nose at anyone. If he has decided that a direction must be*

followed, he will not be satisfied until he has reached it". Another example of a reluctance toward the others' opinions is given in the following excerpt:

> *Our hotel manager is not very inclined to listen to us subordinates, but I have to admit that this attitude was successful during the emergency. During that period, we could not waste time, but we were all afraid of making decisions. Fortunately, our manager made decisions as quickly as possible, and this was ideal in the situation we were living.*

This prejudice subsequently impacts the decision-making process, but the responses of the interviewees showed that the tendency to be overconfident in their own beliefs caused executives to behave in the best way possible during the COVID-19 pandemic and that this attitude is frequently driven by the occurrence of meaningful coincidences. For example, the following excerpt from interviews illustrates this perspective in detail:

> *During the pandemic, our hotel manager very often made decisions simply based on his experiences or randomness, and this attitude led him to choose well and achieve excellent results. (…) We all trusted him; he was so confident. I believe that he did his best to deal with the emergency, and the results proved him right.*

The last recurring aspect in interviews with subordinates concerning managers' decisions in dealing with a crisis is overplacement. This refers to a belief that one's knowledge, predictions, or abilities are superior to those of one's peers (Navis and Ozbek, 2016). This explains why many people expose themselves to risk, even when doing so puts their health and lives at risk (Thaler and Sunstein, 2008). *"Our manager always puts his heart and soul into his job, and he doesn't believe he has a rival in what he does. In February 2020, he was the first to propose the use of personal protective equipment (PPE) before the State mandated it"*, an interviewee reported. Subordinates' perceptions suggest that executive overplacement allowed them to cope with uncertain and turbulent contexts and that very often this attitude stems from a series of meaningful coincidences experienced by the executive. Another example is given in the following excerpt:

> *Our executive constantly believes that he is better than other hotel managers. In the darkest moments of the virus emergency, this trait has provided a glimmer of hope. He may seem arrogant, but I trust him completely. (…) When the pandemic broke out, our manager told us that he dreamt of a bloody and violent war. (…) This feeling gave him the certainty and foresight that COVID-19 would lead an epochal conflict in our lives,*

and in early March he made major financial investments to bring the hotel up to safety standards to contain the spread of the virus, allowing guests to have a relaxing and safe stay. (…)

As mentioned above, the executive's feeling made him sure that he had sufficient information to make the best choices, making risky decisions with unpredictable outcomes, such as disbursing substantial financial resources during a turbulent and uncertain period.

5 Discussion

This work aimed at answering the following research question: "How does executive confidence led by meaningful coincidences influences management decision-making during turbulent times?" The occurrence of meaningful coincidences associated with executive confidence have been underestimated in the literature, but these elements provide insight into how managers make decisions that are not based on rationality (Cristofaro, 2020).

Our work offers several contributions to theory and research. First, we address the call from Heavey *et al.* (2022) to provide new insights into the bright side of executive confidence – which has previously been studied mainly from a negative perspective – and identify some managerial attitudes that represent critical variables in relation to positive executive confidence in uncertain times. Moreover, we respond to Hussain and Khan's (2020) request for studies on the experiences of hospitality facilities in uncertain and turbulent situations, by offering valuable information into how an hotel manager should act during crisis periods. By answering the call for studies on business situations in which rationality must give way to affective states (Cristofaro, 2019), this contribution suggests that the occurrence of meaningful coincidences can positively influence executive confidence, allowing hotel managers to respond to the needs of chaotic and turbulent settings. Finally, in response to calls from the literature on the effects of meaningful coincidences on decision making (Cristofaro, 2020), this research highlights the process through which meaningful coincidences lead to the three different characteristics of executive confidence during the decision-making process – that is, overestimation, overprecision, and overplacement.

According to subordinates' perceptions, executive confidence led by meaningful coincidences can positively influence managerial decision-making by implementing efficient tactics to promote change while establishing an overall

vision, setting ambitious priorities, and motivating people to work. The illusion of certainty and the occurrence of meaningful coincidences made the hotel manager believe that he or she had enough information to make risky decisions which brought unpredictable and favorable outcomes, such as investing huge financial resources without knowing exactly what scenarios would arise. Subordinates' perceptions revealed that confident managers whose choices are led by meaningful coincidences are not very satisfied with what they have, so it is possible for them to implement ambitious strategies to respond quickly to the surrounding environment. According to our findings, these aspects constitute an essential attitude for management because they direct executives and keep them moving forward to achieve goals in the face of uncertainty. Guided by these traits, a manager may be able to lead staff and deal with specific situations, such as the uncertain environment of the hospitality industry during the COVID-19 pandemic. Through meaningful coincidences, the manager may be also able to make decisions by going beyond the traditional boundaries of rationality, providing a solution to crisis situations. Thus, the results, which are consistent with several studies on the decision-making process of confident managers (e.g., Banerjee *et al.*, 2014), and on the occurrence of meaningful coincidences (Cristofaro, 2020), indicate that they positively influence decision-making process.

The results also have important practical implications. Our findings indicate that managers should consider the occurrence of meaningful coincidences, as these increase their confidence and allow them to perform well, even when faced with a turbulent context. In addition, another practical implication of this study concerns the new idea of skills required for management. After the COVID-19 pandemic, new skills must be considered, such as capacities for rapid adaptation to changes and unpredictable conditions, and to deal with abrupt changes without taking into account the viewpoints of all staff members. Moreover, thinking beyond the traditional boundaries of rationality can be critical to surviving the post-COVID-19 pandemic business environment, since confident managers whose decision-making is guided by meaningful coincidences can find themselves one step ahead of the competition during uncertain periods.

This study is not without limitations, including the choice to focus on a particular historical period such as COVID-19. Since this was a very uncertain and chaotic period, further research is needed on different historical periods to bring more rigor and value to these exploratory insights. Furthermore, although this study followed qualitative research methods conducted with rigor, the data are

limited by the inherent subjectivity of the participants' opinions. Similar research questions could be tested in the future on a larger sample through surveys or other methods of quantitative research. Further research may also help to better distinguish between positive and negative executive confidence led by meaningful coincidences.

6 Conclusion

This study found that manager's subordinates showed overall positive evaluations of managers' behavior guided by meaningful coincidences in high-performing Italian hospitality facilities during the COVID-19 pandemic. Through interviews with 24 participants, the subordinates' perceptions demonstrated that when an organization faces uncertain and turbulent times such as the COVID-19 pandemic, the occurrence of meaningful coincidences increases executive confidence, enabling managers to deal effectively with the obstacles and ambiguities of the context in which they operate.

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The Factors Influencing the Growth of SMEs in the EU Pharmaceutical Industry: An Empirical Analysis

Arif Ibne Asad

Department of Economics,
Faculty of Management and Economics
Tomas Bata University in Zlin, Czech Republic.

Ali Sufyan*

Department of Economics
Faculty of Management and Economics
Tomas Bata University in Zlin, Czech Republic.

Gul Shah Sabary

Department of Enterprise Economics,
Faculty of Management and Economics
Tomas Bata University in Zlin, the Czech Republic.

Boris Popesko

Department of Business Administration, Faculty of Management and Economics Tomas Bata University in Zlin, Czech Republic.

** Corresponding author*

Abstract

SMEs are the economic backbone of Europe. In pharma companies, SMEs are the engines of innovation, playing a critical role in the creation of novel medications for patients. However, in reality, the scenario is not so favourable, and the objective of this research is to identify potential factors of negative growth in the pharmaceutical industry. The study used secondary data from the EU Industrial R&D Investment Scoreboard in 2015 and 2020 to apply a multiple linear regression model, with the dependent variable being operating profit. The results are very interesting, for example, the nest sale has positive and operating profit has negative coefficients throughout the years, implying that operating expenses, costs of goods sold, and day-to-day costs are higher than sales revenue in most cases. In the model, we get that R&D expenditure is having a positive relationship in 2015 but an insignificant probability value; however, it is negative and highly significant in 2020. Likewise, R&D expenditures, the capital expenditure also does not go through identical

patterns in these two periods. Therefore, further studies are required to go through several years to generalize an exact relationship among the variables.

Keywords – Factors, Growth of SMEs, Pharmaceutical Industry, the European Union, Empirical Analysis

Nature of proposed paper - Academic Research Paper

1 Introduction

The COVID-19 pandemic creates inefficiencies in the healthcare system by having devastating consequences. It has demonstrated how inefficiencies in the health system can significantly impact social cohesion, economic growth, and public confidence in government (OECD, 2022; Blumenthal, Fowler, Abrams, & Collins, 2020). In that instance, Europe was not an exception, while the pharmaceutical sector is a highly capital and knowledge-intensive industry in the world, the amount of investments necessary to meet the rising problems in the demand for health care is what characterizes the pharmaceutical industry, (Mennini, et al., 2016), which spends around 15 % of the total revenue on research and development (R&D), (Downs & Velamuri, 2018). Besides, European Union (EU) has the second largest market by sales account in the world and the increment of total investment becomes more than doubled during the pre-pandemic period (Azierta, 2019).

Our research focuses on the factors of negative growth of the pharmaceutical small and medium enterprises using a sample of pharmaceutical firms in the European Union in 2015 and 2020. To accomplish the research, we conduct several chapters in this paper, such as initially discussing the literature review with the titles of the role of SMEs in the pharmaceutical sector, and factors influencing the growth of SMEs end of the literature, we focused three hypotheses based on it and the emergence of the problem statement. In the next chapter we designed, materials and methods, where the methodology and data collection procedures have been discussed. The result section is divided into two parts, such as descriptive statistics and estimation of the coefficient of the models. Then, finally, it concludes the remarks.

2 Literature Review

2.1 The Role of SMEs in the pharmaceutical sector

SMEs are the economic backbone of Europe. They account for 99% of all enterprises in the European Union and engage two-thirds of all private-sector workers (Lahkar et al., 2021). In pharma companies, SMEs are the engines of innovation, playing a critical role in the creation of novel medications for patients. SMEs are self-contained businesses with diverse workforce counts from one territory to the next. SMEs have been credited for driving pharmaceutical innovation in the United States and Europe, such as the development of new products, methods, and services (D'Amato et al., 2020). There is evidence that SMEs haven't yet performed a substantial role in pharmaceutical sector innovation in history. It has been stated that SMEs have helped the process of innovation by transforming the traditional "industry and academic" research paradigm into a triangle model. Meanwhile, several other studies have disputed this. Strategic partnerships in the United States among small pharmaceutical enterprises and large pharmaceutical enterprises reveal that the latter is more interested in partnerships for financial utilization rather than discovery (Sieckmann et al., 2018). This exposes the little drug enterprises to suffer the consequences of time. A careful examination of the pattern in the US pharmaceutical industry showed that SMEs have generated outstanding sales growth while maintaining poor profits compared to the pharma industry as a whole (Khoury et al., 2021). SMEs' performance in pharma depends on several essential variables, including innovation, research and development, marketing, contract production, and job placement. The power of partnership, a contemporary trend in the pharma industry, provides opportunities for SMEs in the pharma sector in terms of innovation (Sharma, 2016).

With developed nations' attempts to stimulate innovation, there is a chance that SMEs will gain from such endeavors, which will contribute to economic development. The pharma sector will aid SMEs by sharing knowledge in producing and promoting new goods or procedures. With the cooperation, SMEs will have access to freshly developing manufacturing technology. Furthermore, SMEs collaborations help enhance SMEs' innovation and performance in the worldwide pharmaceutical sector (Bagchi, 2010). Marketing is an important aspect of the pharma business. Insufficient funds might impede the successful entry of

pharma commodities into the marketplace or pharma products into the worldwide market. Partnerships for pharmaceutical drug promotion from SMEs can assist enhance revenues and offer an effective outlet for pharma brand selling both regionally and globally (Renko et al., 2005). Industrial production can be both financial and labour-demanding, necessitating a highly skilled and professional staff. Several businesses may confront issues with enough capital and labour expertise. Pharma SMEs might gain an edge by outsourcing the manufacture of their medications to worldwide production businesses. The ability of SMEs to leverage the knowledge of contracted manufacturing businesses will allow them to concentrate on primary competencies (Wikhamn et al., 2016). This method can reduce operational expenses while also increasing manufacturing process performance. Considering the introduction of novel industrial innovations, there is a greater necessity to train workers in modern technology. Worldwide pharma companies will help emerging nations educate the staff required to keep up with the company's technical changes (Ahmed-Ishmel et al., 2018).

2.2 Factors Influencing the Growth of SMEs

Numerous pieces of research on SMEs have been conducted on numerous topics about this industry. Among the subjects discussed in the literature are safety, technological utilization, personnel, performance, knowledge, strategy, and financing. Two out of every three employees in the private business are held by SMEs, according to (Ansu-Mensah et al., 2021). The importance of operational support for the industry was also emphasized by the scholars. According to the survey, SMEs confront difficulties such as inadequate information technology utilization, restricted financial availability, poor research and development spending, a scarcity of databases, low levels of monetary involvement, and inefficient distribution channels. These were held responsible for the SME sector's poor growth. Nikolić et al., 2019 concentrated on the impact of loan availability on SMEs' growth and operations. According to Nikolić et al., 2019., SMEs' ability to access loans is crucial to their sustainability and expansion. It is further claimed that regulators ought to support financial industry regulations that encourage financial facilitators to provide services and products that are suitable for SMEs. The expansion of small enterprises is severely constrained by the majority of SMEs' inadequate access to funding. The reasoning is predicated on the idea that

money is necessary for investments in reformation and innovations, among several other things (Wahab et al., 2016).

The impact of competition and globalization on SMEs was examined by (Thompson Agyapong et al., 2018) According to the report, globalization brought about technological advancements and increased levels of competitiveness. Park et al., 2019 evaluated the issues SMEs face. They also examined how easily SMEs could obtain credit from conventional financial institutions and how government policies affected their development and day-to-day operations. According to the survey, financial institutions were providing SMEs with insufficient financial support. It was discovered that the sector's expansion was also being constrained by an unpredictable overall economy. Lomatey et al., 2020 studied the difficulties SMEs face while trying to raise money. The study employed the social capital theory to demonstrate how difficult it is for SMEs to raise money. Other issues that have been looked into include insufficient security, unclear information, low technical proficiency levels, poor management capabilities, competitiveness, a lack of competence, and the absence of appropriate credit agreements. Njanike, 2020 researched the obstacles SMEs encountered that affected their productivity, expansion, and company operations. The results demonstrated a lack of govt assistance, unfavourable local authorities treatment, competitive pressures, a lack of marketplaces, a lack of financing, unfair local authorities treatment, increased competition, an insufficient amount of training, and low rates of technological use. Inadequate infrastructures and supplier distrust were also mentioned as barriers to SMEs formalizing their operations (Bouazza et al., 2015).

2.3 Hypothesis of the Study

H1: The relationship between net sales and operating profit is expected to be positive.

H2: The relationship between R&D expenditure and operating profit is expected to be positive.

H3: The relationship between capital expenditure and operating profit is expected to be positive.

3 Materials and Methods

3.1 Data

The conceptual framework of the study is designed through secondary data. The data includes the growth of pharmaceutical company-level variables, such as operating profits, net sales, market capitalization, R&D spending, employee count, and capital expenditures for pharma SMEs. In addition, the firm-level data of the above-mentioned variables are also obtained. The information can also be found in reputable sources like the European Commission, European Medicines Agency, and the EU Industrial R&D Investment Scoreboard. The financial statement, annual report, and other disclosure documents of the company are used to gather firm-level data for the in-depth analysis of negative operating profit.

3.2 Method and Data Analysis Process

The analysis will be done through descriptive statistics and a multi-variable regression model from the panel data. By fitting a line to the observed data, regression models are used to describe relationships between variables. Regression estimates the change in a dependent variable as the independent variable(s) change. To estimate the relationship between two or more independent variables and one dependent variable, multiple linear regression is used. Econometric software, such as Microsoft Excel, and STATA-14 will be used to analyze the results.

The process first recognizes the SME pharmaceutical companies and then estimates the multiple linear regression model. In the case of, recognition of the particular SME companies, we applied the turnover ratio of the company by net sales, if net sales are less than $50 million, we consider the company in this group.

4. Results

4.1 Descriptive Statistics

According to European Commission (2021), "Small and medium-sized enterprises (SMEs) are defined in the EU recommendation 2003/361". There are

two main factors determining whether an enterprise is an SME or not, staff headcount either turnover or balance sheet total.

Table 1: The European Commission criteria for SMEs

Company Category	Staff headcount	Turnover	Balance sheet total
Medium-sized	< 250	≤ € 50 m	≤ € 43 m
Small	< 50	≤ € 10 m	≤ € 10 m
Micro	< 10	≤ € 2 m	≤ € 2 m

Source: European Commission (2021).

Small and medium-sized businesses (SMEs) in the biopharmaceutical industry are major forces behind innovation in Europe. They have a significant impact on the creation of novel medications, especially in fields like biology, future pandemics, infectious diseases, and uncommon diseases and these fields are neglected due to technological obstacles or lower expected market potential (EFPIA,2020). Diverse financing sources are crucial for fostering innovation in the pharmaceutical sector. National programs R&D, including for small and medium-sized firms (SMEs) and academia, will be a fundamental component of the Strategy's assistance (European Commission, 2020).

But reality always has a few ugly edges. Numerous businesses in the European Union experience incredibly low profitability year after year. For instance, one medium-sized company, MEDIGENE AG in Germany, had 142 employees overall in 2019 and 121 in 2020. Although there is still a persistently negative net profit, such as -19,962 in 2019 and -28,875 in 2020. Not only Germany, but other leading economies also has several pharma companies with negative operating profit over the years. Table 2 just represents a sample of the data set in 2015 negative operating profit, while the data since 2020 shows strong evidence of it.

Table 2: Operating profit loss (€ million) in EU pharma Industry

Country	year	Total companies facing negative OP	OP loss in total
United Kingdom	2015	21	-546.3
Germany	2015	5	-149.6
France	2015	11	-213.3
Denmark	2015	6	-1089.4
Netherlands	2015	5	-146.5
Ireland	2015	4	-2973.1

Source: European Commission (2023)

The majority of businesses, including EU pharmaceutical companies, have negative or zero operational profits, as shown in Table 1, while net sales, capital outlays, and R&D investment have increased over time.

Table 3: Pharmaceutical Companies in the EU with negative or zero operating profit

Year	Total number of firms	Firms with negative or zero operating profit
2015	133	82
2016	150	89
2018	166	99
2019	159	102
2020	143	90

Source: EU Industrial R&D Investment Scoreboard (2023).

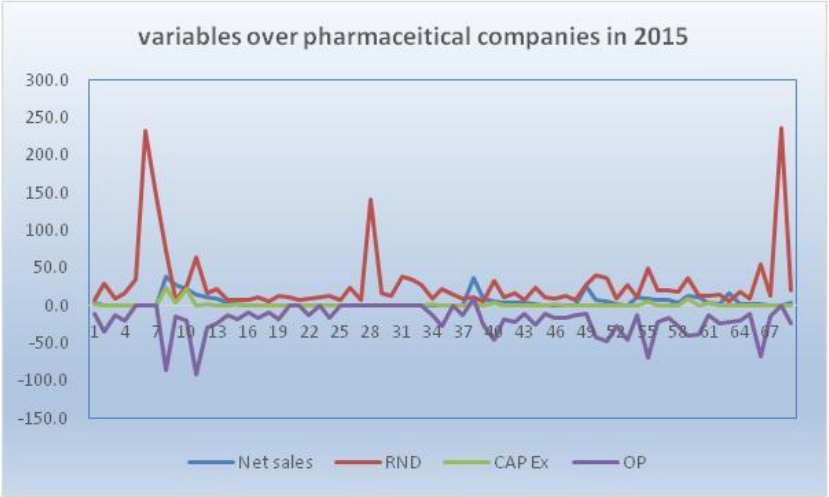

Figure 1: The variables over EU pharmaceutical companies in 2015.

The figures show that operating profit is having zero and negative values throughout the companies. While R&D expenditures are containing greater values in both years to the pharmaceutical companies in the EU.

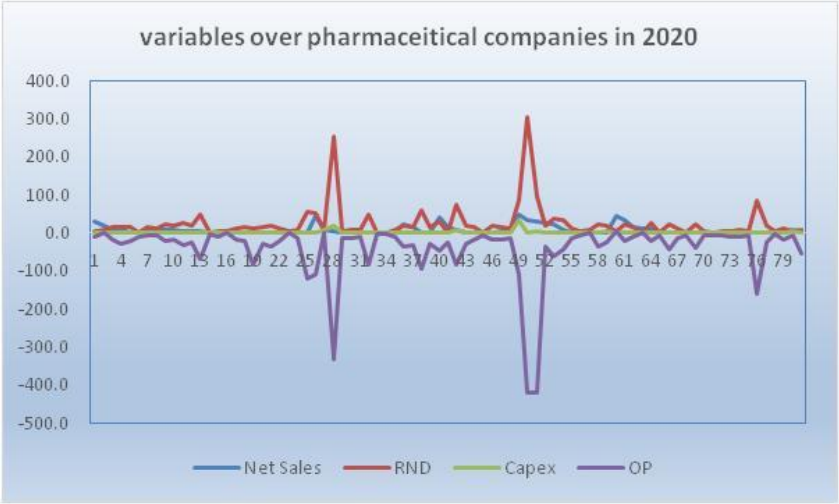

Figure 2: The variables over EU pharmaceutical companies in 2020.

4.2 Empirical Models and Estimations

We estimate the following multiple linear regression model by using the econometric software STATA-14.

$$\mathbf{Op} = \boldsymbol{\alpha} + \boldsymbol{\beta}\ \mathbf{netsales} + \boldsymbol{\gamma}\ \mathbf{R\&}D + \delta\ CapExp + \mu$$

Where, OP= Operating profit of the company in a particular year
α = constant or intercept term
β = the interaction coefficient for net sales
netsales = Net sales of the company in a particular year
γ = the interaction coefficient for Research and Development expenditure
$R\&D$ = Research and Development expenditure in a particular year
δ = interaction coefficient for capital expenditure
CapExp = Capital expenditure for a particular year
μ = error term

Table 4 displays the projected results of the multiple linear regression model, which has two parts: one for the cross-sectional data for the year 2020 and another for the cross-sectional data for 2015. It includes panel data when combined. The procedure first identifies SMEs and small pharmaceutical companies before estimating multiple linear regression models. In the case of identifying a specific SME company, we used the company's turnover ratio of the company by net sales; if net sales are less than $50 million, we consider the company to be in this group.

To avoid the impact of non-constant variance, we use a robust regression model rather than a simple multiple regression on the data for the years 2015 and

2020. The robust multiple linear regression model is useful in this regard because it implies different standard error values, which control the model's heteroscedasticity problem. Stata-14 software was used to perform the Breusch-Pagan / Cook-Weisberg test for heteroskedasticity.

Table 4 (a): Estimated Results of the Multiple Linear Regression Model

Dependent Variable: OP
Method: Least Square
Observation: 69
Year Value estimated: 2015

Variable	Coefficient	Robust Standard Error	t-statistics	Probability
_cons	-14.84196	2.256381	-6.58	0.000*
net sales	-0.4533791	0.60478	-0.75	0.456
R&D	0.0014992	0.048464	0.03	0.975
capex	-1.360881	1.207344	-1.13	0.264
R-squared	0.1826			
Adj R-squared	0.1449			
Prob > F	0.0978			

Note: * indicates a 1 % significance level. (Source: Authors' estimation)

Table 4 (b): Estimated Results of the Multiple Linear Regression Model

Dependent Variable: OP
Method: Least Square
Observation: 81
Year Value estimated: 2020

Variable	Coefficient	Robust Standard Error	t-statistics	Probability
_cons	0.9885575	3.180403	0.31	0.757
net sales	-0.4005767	0.4681217	-0.86	0.395
R&D	-1.486248	0.1438423	-10.33	0.000*
capex	0.650943	0.6969763	0.93	0.353
R-squared	0.8001			
Adj R-squared	0.7923			
Prob > F	0.0000			

Note: * indicates a 1 % significance level. (Source: Authors' estimation.)

When we compare the results from Table 4(a) and Table 4(b), we can see that the estimated coefficients have useful interpretations, such as "only the relationship between operating profit and net sales is similar in these two periods as negative", while the other variables, R&D expenditure and capital expenditure, vary depending on the years. The relationship between net sales and operating profit is indeed negative in these SMEs of pharmaceutical companies in the European Union, implying that net sales do not provide the strength for these companies to have a positive operating profit, which will suffer in the future for sustainability if there is insufficient profit generation. Operating profit is calculated as follows: Operating Profit = Revenue - Operational Expenses - Cost of Goods Sold - Day-to-Day Costs (like depreciation and amortization). Operating profit is significant because it allows businesses to evaluate their financial performance. In most cases, the operating profit of firms is negative, while net sales are positive from the data set, therefore, the operating expenses, costs of goods sold, and day-by-day costs are higher than the sales revenue. Negative profit margins can temporarily halt those activities, affecting both investors and your company's access to credit. It is not desirable for businesses' sustainability.

R&D spending does not guarantee profitability or strong stock performance on its own. When projects are deemed successful, some companies see a payoff from investing heavily in R&D. Companies, on the other hand, can suffer from poor performance losses despite investing heavily in R&D each year (Morbey, 1989). In the model, we get R&D expenditure having a positive relationship in 2015 but an insignificant probability value; however, it is negative and highly significant in 2020 as a p-value of less than 0.05 implies significance and that of less than 0.01 implies high significance. Therefore p=0.0000 implies high significance. Similar to R&D expenditure, capital expenditure does not signify the same direction for both periods. In 2015, it is negative and insignificant but in 2020 it is positive and insignificant. The actual cost of capital expenditure has no immediate impact on the income statement, but depreciation gradually reduces profit on the income statement over the asset's life. However, depending on the type of asset, capital expenditure may have an immediate impact on the income statement in other ways.

5 Conclusion

SMEs are the economic backbone of Europe. In pharma companies, SMEs are the engines of innovation, playing a critical role in the creation of novel medications for patients. SMEs have been credited for driving pharmaceutical innovation in the United States and Europe, such as the development of new products, methods, and services. However, numerous businesses in the European Union experience incredibly low profitability year after year. The study will focus on an empirical analysis of the factors influencing the growth of pharmaceutical SMEs in the EU.

But in reality, the scenario is not the EU Industrial R&D Investment Scoreboard t so favourable, the study aims to find out the potential factors of negative growth in the pharmaceutical industry. The study collected secondary data from the EU Industrial R&D Investment Scoreboard in 2015 and 2020 to apply a multiple linear regression model, where the dependent variable is the operating profit, which has very interesting results, for instance, the nest sales and operating profit have negative coefficients throughout the years, which implied that the operating expenses, costs of goods sold, and day by day costs are higher than the sales revenue as most cases operating profit is negative; however net sales are positive throughout companies. In the model, we get that R&D expenditure is having a positive relationship in 2015 but an insignificant probability value; however, it is negative and highly significant in 2020. Likewise, R&D expenditures, the capital expenditure also does not go through identical patterns in these two periods. Therefore, further studies are required to go through several years to generalize an exact relationship among the variables.

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Coordination Mechanisms from Telemedicine Practices: Three Case Studies in Italy

Mattia Vincenzo Olive*

School of Management
Politecnico di Milano
Via Lambruschini 4, Milan (Italy), 20156

Luca Gastaldi

School of Management
Politecnico di Milano
Via Lambruschini 4, Milan (Italy), 20156

Chiara Sgarbossa

School of Management
Politecnico di Milano
Via Lambruschini 4, Milan (Italy), 20156

Mariano Corso

School of Management
Politecnico di Milano
Via Lambruschini 4, Milan (Italy), 20156

* *Corresponding author*

Abstract

Although telemedicine practices may be traced back to decades ago, their real potential has only been recognized during Covid-19 outbreak. As the pandemic has abated, the implementation of telemedicine has revealed many managerial considerations that are crucial for its optimal deployment. The technical and social connotation of telemedicine is central for both understanding and promoting its implementation. This dual nature has been shown to peculiarly affect the organization of work, in particular coordination among health professionals. This study investigates which coordination mechanisms are enacted within telemedicine services among health professionals and how these mechanisms unfold to achieve collective performance within these services. To do that, three case studies, concerning telemedicine services provided by public healthcare organizations in the Italian context, were analysed. Results shed novel light on coordination mechanisms enacted within telemedicine services and their integrated conditions, meant as the

instruments through which coordination mechanisms unfold to achieve collective performance. Practical implications are discussed to support managers in interpreting how coordination mechanisms work within telemedicine services and consequently how to effectively design them.

Keywords – Coordination, Organization, Telemedicine, Healthcare

Paper type – Academic Research Paper

1 Introduction

Although telemedicine practices may be traced back to decades ago (Hjelm & Julius, 2005), their real potential has only been recognized in recent years. Covid-19 pandemic acted as catalyst for the awareness and diffusion of telemedicine, which – during lockdown – had essentially become the only possible manner to provide non-urgent medical services (Lukas et al., 2020).

This unprecedented awareness on telemedicine has led to the introduction of related policies and investments, addressing issues such as public reimbursement, data privacy, infrastructures, etc. (Bokolo, 2021). The Italian context is representative in this sense, as telemedicine has been central in the process of reform of the Italian National Health System (NHS), mainly through the National Recovery and Resilience Plan[1].

As the pandemic has abated, the implementation of telemedicine has revealed many managerial considerations, which are crucial for its optimal deployment. The complexity of integrating telemedicine within current practice is linked to the extension of the concept itself. In fact, telemedicine has been defined as the *provision of health services at distance*[2] and it is substantially characterized by a technological connotation (mainly related to digital technologies), as well as social implications (Bashshur et al., 2011).

The dual technical and social-related connotation of telemedicine is central for understanding and promoting its implementation (Khodadad-Saryazdi, 2021). In particular, this dual nature has been shown to peculiarly affect the organization of work (Barlow, 2015; Khodadad-Saryazdi, 2021; Nicolini, 2006, 2007). Nicolini (2006) argues how telemedicine affects coordination, through task shifting in the form of delegation of medical work towards non-medical roles (e.g. nurses) and

[1] *Available at: https://www.governo.it/sites/governo.it/files/PNRR.pdf*
[2] *Available at: https://apps.who.int/iris/handle/10665/357828*

affecting the "geography of care delivery". Thus, coordination emerges as a central concept for understanding how medical work changes with the introduction of telemedicine, both from a theoretical and practical standpoint.

From a theoretical viewpoint, the significance of telemedicine lies in its capacity to embody the sociomaterial entanglement of technology and service, thus serving as peculiar and example case for our understanding of coordination (Orlikowski, 2007). However, this potential has not been fully explored, with respect to studies related to other technological domains in healthcare settings (see, for example, Sergeeva et al., 2020).

From a practical perspective, understanding how coordination mechanisms unfold within telemedicine services is of paramount importance for their effective design. This is particularly significant given the growing prevalence of telemedicine services in various national healthcare systems. The Italian NHS, for instance, calls for further coordination among healthcare professionals – including specialist doctors, general practitioners (GPs), and nurses – both within and across organizations. In this regard, the responsibility of ensuring coordination falls on the new roles and organizations established through healthcare system reforms[1]. To that end, it is essential for healthcare providers offering telemedicine services to work toward process and organizational convergence.

Finally, over the years, the scientific literature in the medical field has extensively discussed the matter of coordinating care with a pragmatic approach, often aimed at gathering evidence of the efficacy and effectiveness of integrated and coordinated care. Several articles have addressed this concern in diverse specializations, including – among others – diabetes (Northwood et al., 2022), cardiology (Doughty et al., 2002), gastroenterology (Chey et al., 2021), oncology (Kaasa et al., 2018). There is also evidence linked to the introduction of telemedicine within coordinated or integrated care (see, for example, Hays & Skootsky, 2022; Palmer et al., 2021; Pluymaekers et al., 2021; Silva-Cardoso et al., 2021; Sinsky et al., 2021; Tourkmani et al., 2021). This underscores the presence of an empirical problem, which offers the opportunity to analyse the issue from a theoretical viewpoint and derive practical conclusions with a more distinctly managerial approach.

[1] *More information available at: https://www.quotidianosanita.it/allegati/allegato1655970392.pdf*

Given these premises, this study investigates which coordination mechanisms are enacted within telemedicine services among health professionals and how these mechanisms unfold to achieve collective performance within these services.

An overview on the main relevant issues concerning the empirical setting is hereby provided and the theoretical framework adopted within the study is then discussed. As our understanding related to the objective of the study is limited, a multiple case study methodology was adopted to gather data from the actors involved in the phenomenon under investigation (Gioia et al., 2013) "within its real-life context" (Yin, 2013). Results are presented and discussed, along with conclusions and limitations of the study.

2 Background

2.1 Telemedicine

One of the currently most acknowledged definitions of Telemedicine is provided by the World Health Organization, which delineates it as the *provision of health services at a distance*[1]. The key feature of telemedicine consists in the physical distance between the actors involved within the telemedicine service, which is typically enabled by digital technologies.

Although the very definition of telemedicine is debated, the taxonomy proposed by Bashshur et al. (2011) clarifies a set of issues that are relevant for this research. Their taxonomy is based on three intersectional dimensions: technology (synchronicity, network and connectivity), functionality (diagnosis, consulting, monitoring and mentoring) and applications (treatment, specialty, disease and site).

The authors wished for the recurrence to a coherent and unified taxonomy not only for scholars, but also for policymakers. This taxonomy is in fact still far from be achieved (Harst et al., 2022), as it can also be noticed by different definitions given to specific telemedicine services among international policies (Edmunds et al., 2017). However, the proposed taxonomy conceptually shows the multi-faced structure of telemedicine, which can be intrinsically considered as a set of technologies, functionalities and applications integrating traditional healthcare service delivery (Bashshur et al., 2011). In other terms, telemedicine can be meant

[1] *Available at: https://apps.who.int/iris/handle/10665/357828*

as an "integrated system of healthcare delivery" , both in presence and at distance, through the deployment of digital technologies (Bashshur, 1995).

Therefore, telemedicine comprises a plethora of different specific typologies of services, such as teleconsultation and telemonitoring. Practical definitions of different common types of telemedicine services are provided in Annex 2 (Glossary).

2.2 Coordination mechanisms: the adopted framework

To investigate how telemedicine changes coordination mechanisms within healthcare services provision, the framework proposed by Okhuysen & Bechky (2009) was exploited. The authors define coordination mechanisms as *the organizational arrangements that allow individuals to realize a collective performance*. Five coordination mechanisms were identified as recurrent in the literature and conceptualized as plans and rules, objects and representations, roles, routines, and proximity.

However, it is argued that coordination mechanisms alone fail to provide a comprehensive view of "how" these mechanisms work. The need for a further level of conceptualization stems from: i) the emergence of different approaches depending on the object of analysis (Crowston, 1997; Gittell, 2000); ii) the "embeddedness of findings in particular contexts", i.e. the fact that past research has investigated coordination mechanisms on a variety of empirical context, resulting not only in a fragmented terminology, but in a difficult comparability among findings; iii) a lack of focus on the means through which coordination mechanisms are enacted, i.e. "how" they happen.

Therefore, Okhuysen & Bechky (2009) went further and identified the three *integrating conditions* depicted in Table 1, through which agents achieve collective performance.

Table 5. Integrating Conditions for Coordination: definitions

Integrating condition	Definition
Accountability	It answers to the question "who" is responsible for specific elements of the task
Predictability	It enables interdependent parties to anticipate subsequent task-related activities, by knowing what the elements of the task are and when they happen
Common understanding	It provides a shared perspective on the whole task and how individuals' work fits within the whole

Source: adapted from Okhuysen & Bechky (2009)

Each of these conditions can be achieved through a combination of coordination mechanisms, which are reported in Table *6*.

The specific approach taken in the precent research is coherent with the perspective of Crowston's work (Crowston, 1997; Malone & Crowston, 1990, 1994), which focuses on task interdependence in situations in which resources are shared among agents, or tasks need to be divided into sub-tasks in order for goals to be accomplished. Therefore, the empirical focus is medical and health professionals' work.

Table 6. Integrating Conditions for Coordination and their Relationship to Coordination Mechanisms

	Accountability	**Predictability**	**Common understanding**
Plans and rules	Defining responsibilities for tasks	Defining responsibilities for tasks Resource allocation	Developing agreement
Objects and representations	Scaffoldings Acknowledging and aligning work	Scaffolding	Direct information sharing Creating a common perspective
Roles	Monitoring and updating		Substitution Creating a common perspective
Routines	Hand-off work	Task completion/stability	Bringing groups together Developing agreement
Proximity	Visibility: monitoring and updating Familiarity: developing trust	Familiarity: anticipating and responding	Familiarity: store of knowledge

Source: Okhuysen & Bechky (2009)

3 Methods

To address the research question, a multiple case study methodology was employed, focusing on coordination mechanisms in telemedicine services as units of analysis.

Following the recommendations for multiple case study theory building (Eisenhardt 1989; Eisenhardt and Graebner 2007), within- and cross-case analyses were performed (Yin, 2013). Cases were selected through empirical sampling, considering the geographical area and legal nature of the organizations where services are provided.

In Italy, Regions have considerable autonomy in defining the organizations of health services delivery, and healthcare provision takes place at various institutional levels, such as Local Health Authorities (LHAs) and hospitals, which follow partially different institutional criteria. All cases were selected in the Italian context to control for policy, political, and regulatory factors that might affect the provision of telemedicine services. Three cases, namely North-East, North-West, and Centre (NE, NW, and CE), were chosen to limit potential biases (Eisenhardt and Graebner 2007) and gather stronger insights (Eisenhardt 1989). Each service includes teleconsultation, telemonitoring and tele-expertise.

Their main features are shown in Table 1. More information is available in Annex 1.

Table 1: Features of the three case studies

Feature/Case	**NE**	**NW**	**CE**
Geographic Area	Northern Eastern Italy	Northern Western Italy	Central Italy
Juridical nature of the organization	LHA	Hospital within LHA	LHA
Dimension	300 patients involved	300 patients involved	4,000 patients involved
Type of patients	Patients with (low risk) heart failure	Diabetics	Various (cardiology, endocrinology, psychology, etc.)
Interviewees	Project Manager (interviewed twice), Doctor (interviewed once) and Nurse (interviewed once)	Doctor (interviewed once)	Doctor (Head of Digital Transformation) (interviewed twice)

To ensure robust data collection, multiple sources of evidence were relied upon, including primary data, such as semi-structured interviews, and secondary data, such as reports, online news articles, and websites.

The interviewees for this study included individuals who were both healthcare professionals and managers. For the region of NE, the three professionals interviewed were a Project Manager, a doctor, and a nurse. In NW and CE, the interviewed doctors held prominent managerial positions, which are commonly referred to as "hybrid" roles in previous studies (see, for example, Mcgivern et al. (2015).

The information from the interviews has been complemented by several other sources of evidence, including institutional websites, academic papers, newspaper

articles, and practitioners' reports. The convergence of evidence, which emerged from data triangulation, has strengthened construct validity (Jick, 1979).

After transcribing the interviews verbatim, they were analysed following the Gioia Methodology (Gioia et al., 2013), identifying theory-driven codes, categories, and themes.

4 Findings

Findings are described based on the integrating conditions for coordination mechanism identified by Okhuysen & Bechky (2009).

4.1 Accountability

By defining who is responsible for specific tasks or sub-tasks, accountability enables clarity for organization members with respect to their shared responsibilities in reaching a common goal (Okhuysen & Bechky, 2009).

Plans and rules contribute to accountability by defining task responsibilities. In Project-NE, effort was put in defining formal procedures concerning the management of patients through telemedicine tools and to make professionals aware of them:

> *"We are defining detailed internal procedures and we are pushing to make them public, so that each professional will be aware of what are their responsibilities." – Project Manager, NE*

Moreover, the roles of pre-existing actors within the organization were "updated". This is particularly true for nurses, who have experienced job enlargement more than other professionals. New professional figures were established as well: within Project-NE, dedicated project managers were assigned to specific parts of the project:

> *"While there is an ongoing negotiation on tasks and activities, which is redistributing tasks and activities among nurses, specialized doctors and GPs, […] the coordinating role for technical deployment were assigned to dedicated Project Managers." – Doctor, NE*

Within Project-NW, telemedicine has been integrated within integrated pathways for chronic patients. These pathways describe the journey of the patient and the responsibilities for each actor who deals with the patient:

> *"We have defined two integrated care pathways: the first one for patients with hyper-glycemia that are firstly treated with urgence; the other one*

concerns patients with insulin infusers, who are followed also through telemedicine services." – Doctor, NW

Therefore, the evidence suggests that:

Proposition 1: Within telemedicine services, accountability is accomplished through the design of new procedures, the definition of new roles and the revision of existing ones.

4.2 Predictability

Predictability enables organizational agents to anticipate the sequence of tasks related to activities, knowing which tasks will be performed and when (Okhuysen & Bechky, 2009).

In Project-NE, the telemedicine platform has a specific functionality that allows health professionals to view which tasks have been carried out and to "activate" new ones, i.e. to request other professionals to perform another task:

"Through our platform it is possible for health professionals to […] view and activate tasks, through a task planner." - Nurse, NE

The interviewed doctor for Project-NW has highlighted that the availability of data gathered through telemonitoring allows for professionals to understand more easily which tasks are needed to be performed:

"Being able to regularly view the data concerning patients managed within the project, it is easy for nurses and doctors to define when it is appropriate to intervene." - Doctor, NW

Finally, Project-CE has developed informative materials and tutorials for both health professionals and patients, consisting in presentations and short videos. Although their purpose is mainly informative, these materials are substantially protocols and they contribute to create a sequence of interdependent actions that should be clear to all the agents:

"These videos and materials are available through a QR code. They are useful to understand the overall process, with a step-by-step approach and they are very easy to follow. […] We also have extended versions, e.g. the one for tele-expertise is 29 pages long." - Doctor, CE

Thus, evidence points out that:

Proposition 2: Within telemedicine services, predictability is achieved through representations of task advancement and patients' status, enabled

by the telemedicine platforms themselves, and through protocols establishing sequences of actions.

4.3 Common understanding

Common understanding is meant as a shared perspective on overall activities and shared goals (Okhuysen & Bechky, 2009).

In Project-CE, common understanding was meant as the understanding of the overall required sub-tasks that make up the overall health service, through both the formalization of procedures and the possibility to visualize the overall process within the platform.

> *"Managing the process through the platform allows to see the unpacking of the different activities (e.g. booking, paying, doing a visit). Now everyone can understand the overall process, with respect to traditional services. Now you can be mad at the patient or to your colleagues knowing that you were right." - Doctor, CE*

Moreover, different professional figures typically intervene in managing care for chronic patients, in both acute situations of follow-ups. The interviewed doctor of NW pointed out that different perspectives are intrinsic of different professional backgrounds. However, the possibility to monitor, visit and manage patients remotely contributes to set appropriate priorities for intervention, both physically and remotely.

> *"Without telemedicine it was difficult for surgeons and clinical doctors to have a common view on the patients, as they prioritize their part of the pathway. It is still difficult, but we are developing agreement."- Doctor, NW*

In the Italian context, much effort is being put on aligning goals between the hospital setting and the territorial setting. In this sense, within Project-NE telemedicine is viewed as a tool to share information as it was not previously done, creating a bridge among actors in different settings.

> *"Usually there has been a lack of direct communication with hospital doctors. This project was born with the aim of not working in silos." - Project Manager, NE*

In conclusion, findings indicate that:

> *Proposition 3: Within telemedicine services, common understanding is enabled by new channels for communication and information provision, as well as the possibility for each actor to "visualize" and understand the overall process.*

5 Discussion

The three cases allowed to gather evidence to improve our understanding on coordination mechanisms enacted within telemedicine services in public healthcare organizations.

From a theoretical perspective, the sociomaterial connotation of telemedicine, which defines its technological and service nature (Bashshur et al., 2011), are fundamental for comprehending the impact of telemedicine on enacted coordination mechanisms. Telemedicine platforms function as coordinating objects and representations, while coordination is enacted also as rules, procedures, and roles defined within telemedicine services.

The purpose of the present study was not only to identify the coordination mechanisms used, but also to further our understanding on how these mechanisms fulfil the three integrated conditions conceptualized by Okhuysen & Bechky (2009).

Accountability, which refers to the awareness of organizational agents regarding their responsibilities for each task and sub-task, depended on the presence of formal procedures associated with telemedicine services. Management took the initiative to promote the diffusion and awareness of these procedures among health professionals. The introduction of telemedicine services in Italy necessitated the revision of pre-existing roles, which are now being distributed among professionals, such as GPs and nurses. Additionally, new roles have been introduced to manage technological deployment and coordination among settings. Finally, integrated pathways, which include telemedicine services, functioned as procedures that define tasks and responsibilities for each agent involved in patient care.

Predictability, which refers to the ability of agents to anticipate tasks or sub-tasks in space and time, was achieved through detailed protocols, which should be easily accessible by professionals, which contribute to clarifying the sequence of actions needed to provide the overall service. The availability of data through

telemedicine platforms enables health professionals to anticipate when it is appropriate to intervene, thus providing predictability. Finally, task planners specifically provide professionals a tool to activate tasks and foresee them to some extent.

Finally, a shared understanding of tasks and objectives relies on the possibility of visualizing and comprehending the overall process of service provision through technology. Furthermore, the availability of data provides a common view on priority setting for professionals who typically have a siloed view of their piece of the process. Lastly, the possibility of communicating and exchanging data among hospital and territory actors activates a virtuous channel that aims to build bridges between these two domains (although these bridges are still a "work in progress").

The examination of the coordination mechanisms that are enacted and "how" they satisfy these conditions offers relevant practical implications. The three integrating conditions are derived from a formal and emergent view of coordination mechanisms. Thus, when designing formal coordination mechanisms for telemedicine services, managers must be aware of how these mechanisms operate among professionals to be effective. It is not sufficient to merely clarify the tools, procedures, and overall formal arrangements; rather, it is necessary to link coordination mechanisms to the integrating conditions to enable their optimal implementation. Understanding how accountability, predictability, and common understanding arise from the organization is a key component of the design of coordination mechanisms.

Within the empirical setting under examination, the evidence is associated with relatively small projects that are currently being implemented. While it already emerged how coordination mechanisms are linked to the integrating conditions, it is also clear that more must be done to enhance their effectiveness. Given the nature of healthcare organizations, accountability is challenging as the structure of belief of professionals affects their perception of accountability "sticking" it to their traditional view. With regard to predictability, the consolidation of these services should contribute to creating "new routines" for health professionals. Finally, common understanding is likely the most overlooked integrating condition, but it is also arguably the most relevant at present time. The awareness of how each actor's contribution is linked to the overall process and objectives is one of the primary missing links between the enactment of coordination mechanisms and their effectiveness.

6 Limitations and future directions

The present study is currently at an initial phase and requires further evidence to support its conclusions. The three case studies will be deepened with more evidence, and additional case studies will be added with a replication logic. To support the reliability of the findings, it would be beneficial to examine case studies related to healthcare providers in various geographical locations and with different legal structures, such as private healthcare providers. By doing so, the evidence linked to the results will be strengthened.

In the future, it is desirable to collect sufficient evidence to discuss not only the coordination mechanisms in use and how they function, but also how they develop over time or with maturity (attributing them the meaning of "organizing structures" as defined by Okhuysen & Bechky (2009)). It would also be useful to examine the dynamics between formal arrangements and emergent practices, deepening the interpretation based on the existing debate.

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Annex 1: The three selected case study

Case study 1: North-East (NE)

"North-East" (NE) is a publicly funded Local Health Authority (LHA) that serves as the sole healthcare provider within its designated regional territory, which renders it an essential entity of the region itself. Its mandate is to manage and coordinate healthcare and social welfare activities throughout the Region. Notably, the Region holds unique regulatory autonomy within the constraints of the Italian constitution. The regional territory is predominantly mountainous, and there are numerous scattered settlements throughout the area. The LHA and the region have a longstanding focus on digital transformation in healthcare, as evidenced by their creation of dedicated strategic support entities.

Project-NE is a service provided by NE, a healthcare organization operating in collaboration with the region and other supporting bodies. This service is specifically designed to address the growing number of chronic heart failure patients, which poses a significant challenge to the healthcare system for the coming years.

The project enables healthcare professionals, such as cardiologists and cardiology unit nurses, to conduct teleconsultations and telemonitoring of chronic heart failure patients. A web-based clinical dashboard provides healthcare professionals with comprehensive data while patients are provided with a smartphone app that includes specific functionalities prescribed by the cardiologist. The platform integrates digitally connected devices, such as implantable devices and smartwatches, to provide healthcare personnel with real-time patient data for a complete clinical overview. The dashboard allows healthcare professionals to monitor patient data and registered parameters, schedule and initiate video calls, and share multimedia files.

Currently, three local healthcare hospitals and clinics manage over 300 chronic heart failure patients within this telemedicine service.

Case study 2: North-West (NW)

"North-West" is a publicly funded LHA situated in the most densely populated Italian Region. It encompasses one of Italy's largest hospitals, in terms of hospital beds, and provides comprehensive clinical and surgical specialties organized

across more than 50 departments. As an LHA, NW also encompasses territorial clinics that provide both health and social care services, with the mission of integrating specialty and social care.

Project-NW is a service designed for patients with diabetes, both type I and II, and it is delivered via a telemedicine platform, allowing teleconsultation and telemonitoring. Teleconsultations are meant for follow-up consultations to monitor therapy and receive specialist prescription. Telemonitoring enables continuous gathering of data related to diabetes-related parameters from sensors. The service was initially developed in NW hospital in collaboration with the Region and has the potential to expand to other healthcare providers. Over 300 patients are currently involved in this project.

The platform used for these services is integrated with the regional Electronic Health Record (EHR), providing access to the patient's entire clinical history. The platform also allows for real-time uploading and viewing of attachments, including documents, images, and videos exchanged between the doctor and the patient.

Case study 3: Centre (CE)

"Centre" is a publicly funded LHA located in one of the most populated Regions of Centre Italy, which provides medical care to over 500,000 citizens. The region encompasses a vast territory of over 3,000 square kilometres, with less than 100 towns and a population density of less than 150 individuals per square kilometre.

The Project-CE has been implemented in the primary hospital of "Centre" as well as in smaller public clinics specialized in specific medical practices within the territory. Telemedicine services have been integrated into various clinical specialties, including cardiology, psychology, dermatology, and endocrinology.

Teleconsultations are commonly used for follow-up appointments and recurrent meetings with chronic patients across various specialties, while telemonitoring is spread for detecting specific parameters, such as glycaemia. To increase accessibility to specialized physicians in remote and isolated areas, such as small towns, a tele-expertise project has been initiated. This project enables GPs to discuss their patients with specialized physicians located in the primary hospital, receiving feedback and suggestions without the need to travel long distances.

Finally, an ECG telerefertation service is provided, which involves a nurse visiting a patient's home and using specialized equipment to transmit the results of the electrocardiogram to a cardiologist at the hospital in real-time. The cardiologist can then request further tests from the nurse as needed.

Annex 2: Glossary

Telemedicine service	Definition
Teleconsultation	Medical consultation to a patient taking place remotely through the employment of digital technologies. In the Italian context is referred to as "televisit" and it may be provided under specific circumstances, e.g. periodical consultations for chronic patients
Tele-expertise	Consultation between doctors who are not in the same physical location concerning the status of a patient, via digital technologies. In the Italian context it is referred to as "teleconsultation"
Telemonitoring	Patient monitoring service involving the use of devices (sensors, wearables, etc.) to gather data from patients concerning clinical parameters
Telerefertation	Provision of a clinical medical report, involving a healthcare professional supporting the patient in performing a specific clinical exam in presence and a doctor providing a medical report based on gathered data

Transformation for Mobile Local Care, with Increased Teamwork, Competence, and Digitalization

Ann Svensson*

University West
Gustava Melins gata 2
461 86 Trollhättan, Sweden

Kristina Nyckelgård

Vårdsamverkan Fyrbodal
Vänerparken 15
462 35 Vänersborg, Sweden

Lena Aggestam

University West
Gustava Melins gata 2
461 86 Trollhättan, Sweden

** Corresponding author*

Abstract

Demographic changes together with scarce resources means that a transformation is needed in healthcare. A national work is on-going in Sweden to change the healthcare system to get it closer to the patients and users. In this transition work mobile local care is an important area. The aim of this paper is to learn and find out important flows of action that drive the healthcare transformation in mobile local care to evolve in a timely movement. A main challenge is the larger number of involved partners with different autonomous political governance, different in size and with different cultures. The study is based on a qualitative study and the collected data is analysed in accordance with the three modalities timing, attentionally, and undergoing as defined Baygi, et al (2021). The used approach opened the horizon of possibilities in a novel way, to understand the phenomenon of transformation in healthcare. The work also reveals that the used modalities have different possibilities for learning related to organizational, digital, and medical conditions. In the further work it would be crucial to study how the learning is interweaved by coinciding flows of action in this context.

Keywords – Transformation, Flow, Healthcare, Digitalization, Learning.

Paper type – Academic Research Paper

1 Introduction

Transformation in healthcare is required due to the demographic changes in the western world, where the population grows older, with more complex diseases (Lindberg, et al., 2017). Healthcare is marked by challenges of scarce resources, lack of digital knowledge and experiences, as well as increased demand for specialized knowledge (Gjellebæk, et al., 2020). Especially, the challenges are prevalent in the rural areas. In Sweden there is a national on-going work performed on national, regional, and local levels called transition to close care, to change the healthcare system to get it closer to the patients and users (translated from SKR, 2022). In this transition work mobile local care is an important area. Mobile local care is about local mobile teams in for example community care, home care and rehabilitation, home monitoring and digital care visits. In mobile local care close cooperation between regions and municipalities, digital transformation and skills supply are pointed out as success factors (translated from SKR, 2022). In this paper the geographical area Fyrbodal, in the western part of Sweden, is studied, where the joint organization "Care Cooperation Fyrbodal" is leading the transformation work. Challenges and knowledge critical to digitalization in healthcare have been identified and outlined (Svensson, et al., 2022) and successful digital transformation requires a healthcare system-wide reorganization as well as changes in ways of working (Vallo Hult, et al., 2019). The opportunities with the digital transformation of health services are far from fully utilized (Svensson, et al., 2021) and there are demands on learning in health service organizations to create more innovative practices (Gjellebæk, et al., 2020). The aim of this paper is to learn and find out important flows of action that drive the healthcare transformation in mobile local care to evolve in a timely movement.

Healthcare systems are complex, emerging from the many interconnected and interdependent elements and their feedback structures, but also the relations with multiple independent elements in the surrounding environment (Linnéusson, et al., 2022). This means that having a holistic approach and being sensitive for the context is critical in the digital transformation (Aggestam and Van Laere, 2012). Therefore, our research is based on a holistic approach and a flow approach as described by Baygi, et al (2021). This gives a possibility to focus on flows of action from a holistic approach, without concentrating on actors or specific stakeholders.

The paper is organized as follows: In the next section we outline the research method and describe the case. The findings concerning important flows of action that drive the healthcare transformation in mobile local care are then presented. In the last section we end up with some conclusion and thoughts concerning future work.

2 Research method and case introduction

The study is based on a qualitative study in a Swedish rural area, which is a part of the national on-going transition work to change the healthcare system to get it closer to the patients and users is (translated from SKR, 2022). The number of inhabitants varies between maximum around 60,000 in urban municipalities to less than 5,000 in rural municipalities in this area. The study produces context-dependent knowledge and experiences with an attempt to understand complex issues in real life (Flyvbjerg, 2006). Participating partners in this rural area are regional public and private healthcare as well as the 15 municipalities in the area responsible for health and social care, social services, and schools (translated from Vårdsamverkan Fyrbodal - Public_Vardsamverkan VG). Descriptions here inform that there are 15 local cooperation groups, one group for each municipality, and the work is performed on strategic and operative levels. Thus, in each municipal areas, there is one primary healthcare center, where most of the primary healthcare centers are governed by the region. But there are also a few healthcare centers governed by private companies. Each healthcare center has its own operative level. Notably, the region and the municipalities have different autonomous political governance, differ in size, and have different cultures.

The large number of autonomous partners and its accompanying size and complexity is a challenge the work must manage. This requires a need to understand the whole picture, use system´s thinking and having a holistic approach, i.e. consider each part from its role and condition in the whole. Close cooperation between regions and municipalities is pointed out as one success factors (translated from SKR, 2022). The transition work is based on a collaboration agreement between the 15 participating municipalities and the region. In this study the specific transformation work is based on the collaboration between each municipality and the primary healthcare center located in each municipal area. The transformation work is in this way based on

the specific local conditions, in collaboration between the municipal healthcare professionals and the primary healthcare centers' professionals in each local area.

The aim with this study is to learn and find out important flows of action that drive the healthcare transformation in mobile local. This means that the process is in focus, not the actors, and a flow-oriented approach was used. The flow-oriented approach has potentials to reveal novel insights for researchers to understand and theorize the temporal dynamics of action possibilities along our overflowing digital world (Baygi, et al., 2021). Furthermore, a flow-oriented approach contributes to learning and includes dynamic aspects, attentional orientation, and an experience for undergoing, as conditions for flows of action (Baygi, et al., 2021). According to Baygi, et al (2021), the three modalities timing, attentionally, and undergoing together explain the dynamics of creation, sensing, and actualization of transformative possibilities for practical actions.

The study started with a workshop identifying teamwork, competence as well as digital work methods as the major challenges that should be focused on to achieve a plan for the transformation. Twelve focus group interviews were then held in each of the rural municipalities in the region. The interviews were aimed to identify ways forward to transform healthcare, of the pace that would be enabled in practice. Each focus group interview lasted for about one hour. Two head nurses from municipality healthcare, together with two heads of the healthcare center located in each of the municipalities, participated in each focus group interview. The focus group interviews were led by the process director from the regional healthcare organization, and one of the researchers participated, observing, and asking a few questions. The data collected at the focus group interviews were analysed deductively, based on the flow approach and the three modalities timing, attentionally, and undergoing as described by Baygi, et al (2021), by thematic analysis (Braun and Clark, 2006).

3 Findings

The transformation work was grounded in local conditions and people because different solutions may need different priorities in different municipal areas. There is a common agreement in this region to work together for the transformation of the rural areas, compared to urban areas, as the healthcare in rural areas has very small resources in relation to the demand of healthcare. Small municipalities may not either have the capacity to act on its own, thus they need to collaborate. In

accordance with the analysis, the findings are presented in the three modalities, as defined Baygi, et al (2021).

3.1 Timing – creating possibilities

The planned actions were focused on the work to remove boundaries between care organizations, trying to cross organizational boundaries. The common work, led by the process director from the regional healthcare organization, gives the opportunity for a neutral party to lead the work forward, in different ways in different municipalities, where there are different conditions for digital solutions. Strategies for digital technologies need to be identified as early as possible, to achieve availability for special needs and for mobile decision support. The boundary-crossing collaboration between different municipal areas and from different organizations offers timing where shared actions are suggested towards transformation of healthcare.

Managers, business developers and other professionals with certain responsibilities were gathered for a workshop to identify common interests and priorities. The aim was also to find common point of departures to support each other in the transformation process. The common base was the local prerequisites and professionals, where different solutions could need different priorities in different local areas. The workshop was a kind of a starting point for discussing these things together. The plan was to investigate the needs in the different local areas, whereas knowing that the coastal and forest municipalities as well as smaller towns could have different needs.

The steering group of the region has decided that the transformation work should be based on local characteristics, be conducted locally, and involve professionals at the local healthcare organizations. The transformation work should also be based on which patients there are in each local area, what competences are available, what equipment will be needed and what competence development that will be needed in each of those areas. Therefore, the professionals have to be asked to identify who will be involved so they could be included in the transformation work. It is emphasized that it is important to ask the professionals about their needs, and to identify the professionals who will be affected to involve them in the transformation work.

The ongoing collaboration between healthcare organizations for the transition of elderly people with complex care needs is a challenging activity. The local

professionals at each municipality and primary healthcare center have to plan and act together to have a seamless healthcare for the patients. However, each local organization has its own prerequisites and conditions to conduct this work. The need for streamlining the work processes to make the work at the hospitals smooth and uniform is identified. Therefore, it is valuable to recognize at each local healthcare organization what they need from the hospital. The region is intended to keep the work together as the small municipalities do not have capacity to analyse their own needs. There is also a suggestion that model municipalities should be selected, with the aim to disseminate knowledge. The joint organization "Care Cooperation Fyrbodal" in this geographical area should act as a facilitator between the healthcare organizations. A coordinator in the "Care Cooperation Fyrbodal" has arranged unconditional meetings between the municipality healthcare and the primary healthcare center in the local contexts.

The transformation process is intended to remove barriers and borders between the healthcare organizations. However, there exist different views on how the collaboration would look like, so this implies challenges. Therefore, a neutral part as "Care Cooperation Fyrbodal" is dedicated to lead the work.

3.2 Attentionality – sensing possibilities

In this work there are intentional planning executed by the process director, led by a group with participants from different healthcare organizations in the region. This gives attentionality to the transformation work where the sensing of possibilities is considered.

There are examples of smaller collaboration initiatives, as projects that have been successful. For example, collaboration with dental hygienists have been implemented in a few municipalities' healthcare. This kind of collaboration has had very good effects in the local healthcare that can be continued on a local basis. There is also an opportunity to arrange workshops with professionals from the rehabilitation unit at the primary healthcare center and the home healthcare in the municipality. To have mobile x-ray equipment with own professionals and to use different digital tools for mobile solutions have also been identified as possibilities, together with the opportunity to have more advanced technical equipment to collect vital parameters and EKG values of the patients to carry out qualified assessment, also before if a physician needs to be contacted. Digital technology could be implemented for the doctor to be able to connect to a

digital appointment, so the patient can stay at home. It is also efficient for nurses to have internet access when they are visiting patients in their homes, to have the ability to contact colleagues at the primary healthcare center. Especially, at the small island in the Bohuslän archipelago, it would be suitable with opportunities for home monitoring, as the patients have a long distance, including trips with ferries, to both the primary healthcare center and the hospital. There could also be arranged for a room at each island, where the social care personnel could assist the patients in the monitoring and contacts with the primary healthcare center or the hospital. Therefore, different considerations need to be taken if it concerns patients who live in inland, coastal, or urban municipalities. However, different examples can give different healthcare teams certain possibilities for development of more efficient work processes based on different conditions.

Possibilities have been sensed for the municipality and the healthcare center to trust each other to prescribe medicines for each other. Other possibilities could be to create assessment teams with different professions for home visits where, for example, both a nurse and a physiotherapist from the municipality can be included. Elderly teams can also be created at the healthcare center, with, for example, elderly nurses and doctors, with different skills and roles. Relationships between assessment teams and elderly teams are identified as valuable to conduct the work in an effective way, and to achieve benefits for the patients, including patients' feeling of security. Moreover, if there were dieticians attached to the hospital the dietary advice to patients could been of better quality.

The healthcare professionals have found out that if they could plan the activities of care for the patients to be conducted at daytime, there will be less activities to conduct at evenings and nights. Some extra work could be avoided if the work is planned preventively for the patients, then there will not be so many questions during the day either. Sending out and disseminating good examples is another thing that the healthcare professionals have found that they can do. If something has been done successfully, it is good to disseminate this for a good exchange of knowledge, experience, and learning.

3.3 Undergoing – actualizing possibilities

The creative transformation work is thereafter undergoing, where the transformative possibilities are actualized, and intentional actions are formulated. With the possibility for a common gathering among the local professionals the

transformation is taken a step forward. The ongoing discussions also imply collaboration between other healthcare departments where for example municipality nurses have dialogues with rehabilitation managers at the primary healthcare center. During the pandemic monthly meetings have also been held between the municipality and the primary healthcare center in most of the municipalities, and this has also been applied with private primary healthcare centers. Reconciliations are also held between primary healthcare centers and the hospital, but the rehabilitation department at the primary healthcare center would also be a partner in this collaboration. The collaboration between the primary healthcare center and the municipality home care, with both physicians and nurses is well functioning in the most areas and is prioritized by the primary healthcare centers.

The transformation work is in its full activity, where the steering group is having meetings to prioritize different activities in different areas in the region. A document is set up, describing all the activities and their priority. A one-day workshop should be held in the near future, where the priorities should be presented for the representatives for the primary healthcare centers and the municipalities.

4 Discussion

Learning is of vital importance in all these three modalities, to provide approaches and conditions for successful transformation. Still, there are demands in learning in this complex healthcare context. New dynamic streams of experiences in the studied context are certainly resulting in learning moments for the professionals (Baygi, et al., 2021). The organizational conditions are interacting with enabling conditions that come from both the digital and the medical areas, that situate the transformation and learning along the flowing lines of action.

4.1 Organizational conditions of possibility

The holistic approach taken from the organizational level are intended to cross organizational boundaries. The intention is also to work together among the municipal areas as small municipalities has not capacity to act on its own, but to consider local varieties of conditions. The timing to have a neutral process director leading the strategic transformation work enable all the included

professionals to learn about the boundary-crossing organizational conditions in each municipal area. There are potentials for learning at boundaries, as emphasized by Lave and Wenger (1991) as well as Engeström and Sannino (2010). From this situational learning, the healthcare organizations together take actions forward in the transformation work.

A coordinating organization in the geographical area acting as a facilitator in the collaboration between the healthcare organizations. The coordinating organization has arranged meetings between the municipality healthcare and the primary healthcare center in the local contexts. Such a structure can build inclusiveness and can meet the network members' expectations regarding participation (Vermeiren, et al., 2021).

4.2 Digital conditions of possibility

Possible use of existent digital technologies is identified in this timing collaboration going on. To sense how digital technologies can be used for different needs is crucial to really exploit digital tools for effective utilization of healthcare, for example for digital care meetings and remote patient monitoring, as well as digital contacts between healthcare professionals. The timing to create such a learning eco-system is made possible through the boundary-crossing collaboration. According to Alrahbi, et al. (2020), this is not possible to achieve this in a dispersed knowledge environment.

To arrange workshops with professionals from different professional areas at the primary healthcare center and the healthcare in the municipality have been enabled by digital video-conferencing tools. This has in turn enabled the healthcare organizations to create teams including various professionals. To sense and learn approaches that can support the digital transformation of healthcare, it is crucial to focus on the healthcare professionals' competencies and experiences, and to integrate their knowledge (Patricio, et al., 2020).

4.3 Medical conditions of possibility

Advanced mobile medical equipment has been developed to support to carry out diverse qualified assessments. Patients' vital parameters, as EKG and other values, could be collected before deciding to send a patient from home to the emergency department at the hospital. Such conditions have been identified as

possibilities in the context of this study. Thus, the professionals from the different care organizations are learning together about medical conditions to move the transformation forward. Schot, et al. (2020) also emphasize the creation of spaces for interprofessional collaboration to bridge knowledge gaps and to overlap in roles and tasks. Moreover, arenas for professional knowledge integration are crucial for their learning processes (Svensson, 2012).

5 Conclusions

Learning is vital in socio-technical transformation in healthcare. The flow approach has been used to identify the flows of action that are crucial elements in the transformation work. The shift from an actor-centric to a flow-oriented approach opened the horizon of possibilities in a novel way, to understand the phenomenon of transformation in healthcare. The transformation work offers timing where shared actions are suggested towards transformation of healthcare. This gives attentionality to the transformation work where the sensing of possibilities is considered. The creative transformation work is thereafter undergoing, where the transformative possibilities are actualized.

The study has also revealed a contingent and conditioned storyline in this healthcare practice. These flow-oriented modalities of timing, attentionally and undergoing have showed different possibilities for learning related to organizational, digital, and medical conditions. Learning is of vital importance in all these three modalities to provide approaches and conditions for successful transformation. The possibilities are also related to boundary-crossing collaboration between health service providers in different geographical areas, organizations, and professions, which give favour to the learning. The possibilities have emerged from the conditions on the move for transformation, that are revealed in this study. The flows are about the continuity in this studied context, and how the possibilities will be followed by further actions. In the further work it would be crucial to study how the learning is interweaved by coinciding flows of action in this context.

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Sustainable Business Models for Vegan Food Production

Paola Demartini*

Department of Business Studies
Roma Tre University
Via S. D'Amico 77 - Rome (Italy)

Adriana Marii

University of Roma Tre
Via S. D'Amico 77 - Rome (Italy

* *Corresponding author*

Abstract

Recent years have seen a rise in popularity of the vegan or plant-based consumption/production, which is deemed to reduce the environmental burden (Fresán & Sabaté, 2019) since the impacts of animal products can markedly exceed those of vegetable substitutes (Poore & Nemecek, 2018).

Our research focuses on sustainable business models applied to vegan production with the aim to scrutinize how companies may achieve positive impacts on people, the planet, and sustainable economic performance. Surprisingly, academic studies by management scholars on this matter are very rare and we discovered that most contributions come from researchers with knowledge and expertise in other disciplines such as environmental science or agricultural and biological sciences.

In light of the above-mentioned literature gap, our explanatory research, based on secondary data (i.e. academic and grey literature), offers an understanding of how sustainable business models can be applied to vegan production.

Namely, we elucidate the concept of Circular Bioeconomy and its applications through biocyclic vegan production and cultured meat production.

Our research highlights that the production of alternative proteins (AP), such as plant-based ones, mostly produced from legumes, may provide benefits not only for the environment but also for human health. However, there is still an ongoing debate on the controversial effects of APs and their nature of being "ultra-processed" food. To deepen this debate, future research should develop an interdisciplinary approach with input from scholars in biotechnology, human nutrition, medicine and management.

Our research has not only theoretical implications but also managerial implications for vegan food production which is undergoing a phase of evolution both in terms of technologies and markets.

Keywords – Sustainable Business Model, Vegan food production, Circular BioEconomy

Paper type – Academic Research Paper

1 Background

The concept of vegan was "invented" in 1944 by Donald Watson, a founder of The Vegan Society and which refers to a vegetarian diet that excludes eggs, dairy products, and all other animal-derived ingredients. Watson wanted to underline the importance of using not only alternative non-animal products in general but also encouraging a vegan lifestyle in relation to the use of any kind of product with the rejection of any animal ingredients or components (Judge & Wilson, 2015). The "veganism style" is not new but it has raised awareness and attention from people in the last few years (Statista, 2018). It is not applied only to food but also to general products, like cosmetics or hygiene products, and it is engaged as a real lifestyle that produces less harm for animals and the planet (Beardsworth, 1991; Loh et al. 2021; Gendel-Guterman& Derqui, 2021).

Due to the growing attention from customers to health and climate change, the global vegan food market is expected to grow in the following years, passing from $23.31 billion in 2020 to $61.35 billion in 2028 (Fortune Business Insights, 2020).

In Europe, the biggest and most important companies in this market are: Danone SA, Hain Celestial Group, Inc, Conagra Brands, Inc., Beyond Meat, Inc., and Nestle SA; companies like these sell their products to retailers which are mainly supermarkets/hypermarkets, online websites, convenience stores, etc. Mostly of consumers make their purchases in supermarkets or big retail stores but, since the pandemic started in 2020, it has also grown the usage of e-commerce for vegan products based on data provided by Google AdWords which showed a growth of 47% of vegan products searches from 2020 (Saari et al., 2021). In brief, the market for vegan food is continuously expanding, being influenced by customers' choices driven by both health and environmental concerns (Apostolidis, & McLeay, 2016; Dedehayir, 2017; Carfì et al., 2018; Cooper et al. 2022).

Beyond these statistics and market trends, the starting point of our research interest is food sustainability (Vermeulen, 2012; Arslan et al., 2021). On the one side, it has been already noticed that some phenomena such as urbanisation,

industrialisation, development, and an increase in the global population, especially in underdeveloped countries, have highlighted important problems related to the food industry. It has been already assessed that meat and dairy industries cause a big amount of negative impacts on the ecosystem in terms of GHGs (Deckers, 2009; Judge & Wilson, 2015; Poore & Nemecek, 2018). Food's environmental impacts are created by millions of diverse producers. With current diets and production practices, feeding almost 8 billion people is degrading terrestrial and aquatic ecosystems, depleting water resources, and driving climate change. Namely, it has been demonstrated that "*impacts of the lowest-impact animal products typically exceed those of vegetable substitutes*" (Poore & Nemecek, 2018, p.987). Hence, a dietary change oriented toward vegetable substitutes of animal products might be an option to consider to meet the requirements derived from the SDS12, driving a more sustainable and eco-friendly food production and supply system (Revell, 2015; Fresán & Sabaté, 2019).

Our study will not discuss the scarcity of food, actual and potential, or the burden on the environment of food production systems, which is already a piece of evidence but it will scrutinise how sustainable business models may be applied to vegan food production systems. Generally, it is well known that the application of circular economy principles to the food production system can help to reduce the negative impacts on the environment (Lu et al., 2022). Namely, this paper will focus on the application of new business models with the aim to scrutinize how vegan companies may achieve positive impacts on the environment, flora, fauna, health, and people's life (Sadhukhan et al., 2020).

A preliminary literature review was conducted by using the following keywords: "vegan production" and "circular economy" or "vegan company" and "business model" or "sustainable production". These keywords were selected to find as much as possible information, research, and case studies both on SCOPUS database and google scholar platform.

Surprisingly, academic studies by management scholars are very rare on this topic and we discovered that most contributions come from researchers in other disciplines such as environmental science or agricultural and biological sciences.

In light of this literature gap, our research, based on secondary data (i.e. academic and grey literature), offers an understanding of how new business models may be applied by vegan companies. The circular economy, in fact, has different and various variants and applications (Brown et al., 2021; Alcade et al.,

2022; Hofmann et al., 2022) which lead to the possibility of developing new models applied to vegan companies.

Our contribution as management scholars is to delve into a hot topic issue, such as the production of vegetal substitutes and alternative proteins.

In this still gray field, the application of technological and process innovations to business activity must follow principles of responsibility and impact assessment that consider individual and collective, private and public interests. Food production is a key issue for humankind's survival and represents what we call a wicked problem. Producing alternative proteins may be an option to reduce environmental impact and respond to the problem of food scarcity, but the phenomenon must be studied in depth and from a multidisciplinary and interdisciplinary perspective. Without a thorough understanding of the short-, medium- and long-term impacts, the risk is that the interests of a few will prevail over those of the community.

The reminder of the paper is structured as follows: section two presents the research design and the methodological issues we faced; section three illustrates how companies that produce plant-based food or companies that decide to shift their strategy towards a vegan and sustainable one can reduce the harmful effects of their processes and generate positive impacts on the environment and human health; conclusions are drawn in section 4.

2 Research Design and Methodology

As well known, studies can be divided into: exploratory studies, which are useful when researchers want to understand a particular problem; descriptive studies, which describe a profile or a situation; and explanatory studies, which explain the relationship between different facets/variables of a phenomenon. (Ghauri et al., 2020). In our case, based on the hypothesis that vegan production is less harmful to the environment, as argued by scholars from other disciplines (Fresán & Sabaté, 2019), we deemed it necessary to start from an understanding of the business models (BM) that can be applied by companies producing vegan products. We therefore chose an explanatory research approach. The latter is a research method that explores why something occurs when limited information is available, as in our inquiry, since vegan food production on an industrial scale is a phenomenon that has spread very recently. Explanatory research can help to increase the understanding of a topic, and ascertain "how" and "why" a particular

phenomenon is occurring. Namely, the aim of this paper is to analyse how sustainable business models are applied to vegan production.

Hence, we formulate the following Research Question:

> *How new sustainable business models applied to vegan production can reduce its burden on the environment and promote responsible food production/consumption goals?*

To answer the above-mentioned RQ we gathered secondary data (i.e. academic and grey literature). Grey literature is materials and research produced by organizations outside of the traditional academic publishing and distribution channels. Common grey literature publication types include reports (annual, research, technical, project, etc.), working papers, government documents, white papers and evaluations.

The outcome of our study is an "explanatory journey", which starting from the Circular Economy applications combined with the Green Economy principles, leads to the design of new business models applied to vegan companies.

3 Sustainable Business Models for Vegan production

Since in the last decade new production systems which are based on the application of the Circular Economy principles have been implemented in the vegan sector, in the following the main features of new business models for sustainable development will be briefly depicted before analyzing the deployment of specific technology to the vegan food production.

3.1. New Business Models for Sustainable Development

One of the most powerful tools and keys to changing the way of producing and doing business has been the passage from the old business models and the old producing mechanisms and processes to the new concept of "Circular Economy" (CE), which has been defined as "*an economic system that emerges to oppose the linear open-ended system (produce, consume, dispose), with the aim to accomplish sustainable development, simultaneously creating environmental quality, economic prosperity and social equity to the benefit of current and future generations*." (Homrich et al., 2018; Reike et al., 2018). Accordingly, The circular business model is a business model that is based on the principles of the circular economy, such as the reuse, repair, recycling and reconditioning of materials and products in order to minimise waste (Zucchella & Previtali, 2019). Circular

business models can be defined as "*business models that are cycling, extending, intensifying, and/or dematerialising material and energy loops to reduce the resource inputs into and the waste and emission leakage out of an organisational system. This comprises recycling measures (cycling), use phase extensions (extending), a more intense use phase (intensifying), and the substitution of products by service and software solutions (dematerialising)*" (Geissdoerfer et al. 2020). Circular business models imply another important feature that is innovation. In fact, the passage from old business models to new ones, circular business models are the result of innovative strategies and methodologies which contributed to its creation. Still, innovation can be generated not only through the design of a new business model, but also through the transformation, the acquisition, or the diversification of an existing one. a company can innovate its business model by only changing some elements or introducing new ones instead of totally recreating a new one.

One last noteworthy theme, is the importance of circular oriented innovation, which represents the combination of product design, business model, and value creation, and helps to the development and the advancement of circular economy strategies (Brown et al., 2021). As this goal sometimes can be difficult to realise by companies themselves, it implies the collaboration among actors and agents, which can be both individuals or firms, with the purpose of exchanging information, expertise, data, and resources to achieve a common goal. Hence, collaborative innovation is needed as it lies in the process of agents' contribution to creating and developing new ideas, products, services, or business models. Creating a network of relationships with different agents and actors is essential for the companies to implement their circular strategies by sharing information and resources in order to be able to accomplish sustainable goals (Brown et al., 2021).

3.1.1 Bioeconomy and Circular Bioeconomy

The Circular Economy is based on reusing and recycling materials minimizing the external negative effects and maximising the utility of each input. In a "carbon-constrained" future where greenhouse gas emissions are limited through policy or technology, a circular economy approach can minimize the impact of the population on the planet (Geng et al., 2009).

Connected to this concept we can consider "bioeconomy" which essentially relies on biological inputs that are used in production instead of fossil fuels and

non-renewable resources. "Bio-based economy" or "knowledge-based bio-economy" (BE) underlines the importance and power of biological resources from land and sea for the manufacturing of products, by substituting fossil fuels with the biomass integrated with biotechnology innovations.

Bioeconomy products consist of biomass and low-value products (i.e., biofuels) and high- value products, such as bio-based chemicals or compounds. (McCormick and Kautto, 2013).

If we think about the application of BE in management production, for example to food production, there has to be proper management of the resources, which is often characterized by a high level of uncertainty, in order to be really sustainable.

Indeed, the use of biomass for unsustainable food production can lead to negative effects on the environment, such as deforestation, and on the society; for this reason, institutions have to release proper regulations and policies not only globally but also in particular in Europe, as BE policies tend to prioritize economic value rather than environmental and social ones (European Commission, 2018).

BE, as it was captured from its definition, can be linked to the CE and transformed in "circular bioeconomy" (CBE), which refers to the concept of bioeconomy integrated with elements of CE. (Institute for European Environmental Policy, 2018; Kershaw et al., 2021; Muscat et al, 2021).

Since we are discussing about vegan production, the Plant Based Products Council, which is the leading organization promoting sustainable products derived from nature, firmly promotes the circular bioeconomy through the creation of renewable products at the market scale and supporting policies that ensure vegan products to become part of the circular bioeconomy. Taken together, these actions reduce carbon emissions, improve water quality, enrich our soil health, and curtail solid waste destined for landfills. (Plant Based Products Council, 2022)

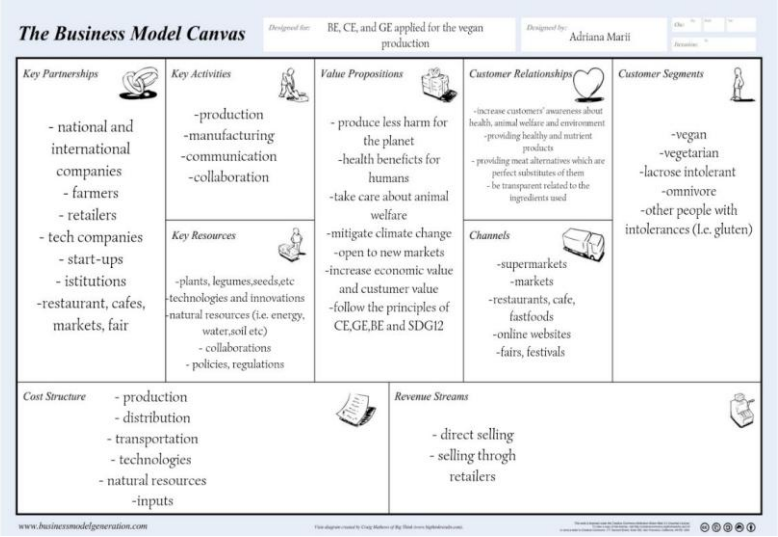
3.1.2 The inclusion of Circular Economy, Green Economy and BioEconomy in the Business Model Canvas

Some initiatives, such as "The Economics of Ecosystems and Biodiversity", state that all three concepts (Circular Economy, Green Economy and BioEconomy) are linked between them by the interest and the effort to preserve nature and, in

general, they are applied based on the same concepts (D'Amato, 2021)(see Annex 1).

Through this excursus of the different applications of a Circular Business Model to the vegan food production, it can be said that these models are necessary to be adopted by companies and substitute the old ones, in order to be able to face environmental issues, and meet the new requirements established by policy makers and institutions.

To our purpose, the inclusion of these principles in a company business model applied to vegan production can ensure positive impacts on planet and society (see Fig. 1).



3.2 Biocyclic-vegan production

In the following, we discuss about a new trend introduced in Germany in 2017, that is named the "biocyclic-vegan" label, which basically refers to the exclusion of any animal by-product during production.

The concept is based on a vegan approach and indeed, in 2016, the producer association "Biocyclic-vegan cultivation" was founded, whose task is to support the biocyclic vegan agriculture by following the guidelines provided by The International Federation of Organic Agriculture Movements - Organics International (IFOAM Organics International).

This new production methodology is based on the combination of organic agriculture and stock-free agriculture, which emphasises the importance of using natural resources and, meanwhile, enabling them to ensure their availability in the future, meaning that they do not have to be depleted.

Essentially, it is primarily based on excluding materials such as horn meal, blood meal and composted manure from farming in the land cultivation, and, as it aims to re-establish a healthy life cycle, coherent with the concept of a closed-loop approach, it is followed by a compensation for the resources that are used in order to guarantee their availability in the future.

Biocyclic-vegan production, in particular in the agriculture sector, is strictly based on the total exclusion of animal products and farm animals, a strategy which strives to increase in the following years, in particular in Germany.

The first countries in which it was introduced and applied vegan biocyclic are Germany, Austria and Switzerland, and are also the ones which follow the labelling guidelines since 2016, in order to be transparent about their production methods (Jürkenbeck et al., 2019)

3.3 Alternative Meat (plant-based and cultured meat) Production

Since animal products are expected to be more requested by consumers, there is an urgency of increasing the production and distribution of alternative products especially alternative meat products made by using innovative food technologies able to reproduce the taste and texture of real meat and meat-based products.

The University of Nottingham (2018) has defined alternative proteins as it follows: "*Alternative protein, such as plant-based meat substitute, or edible insects, provides a substantial amount of protein, but requires less natural inputs (e.g. water) to produce, compared to the most common and conventional protein sources (i.e. meat and fish). They are also called 'novel food proteins' and are composed of different sequences of amino acids, which are responsible for building lean body tissues and human health.*"

Alternative protein of plant-based meat basically refers to alternatives to meat-based protein which replace and replicate it not only in the taste and texture, but also in nutritional characteristics, by trying to be even more economically convenient than meat and to contribute to the environment and to decrease the health negative impacts derived from meat production (BCG, 2021).

One of the most important reasons to produce alternative protein and adopt a different diet consists of the awareness of human health.

Actually, meat causes diseases such as cancer and obesity in relation to its high level of saturated fat, cholesterol, while AP propose to funnel its same nutritional benefits related to the level of protein and essential nutrients with relatively low levels of cholesterol, saturated fats and nitrates. (Chen & Eriksson, 2019)

Cultured meat, instead, is produced by culturing animal cells in vitro using tissue engineering techniques and is presented by its advocates as a good alternative for consumers who want to be more responsible in front of the increasing demand for food by the growing human population but do not wish to change their diet (Chriki & Hocquette, 2020; Reis et al. 2020).

Alternative meat (i.e., plant-based and cultured meat) produces smaller environmental negative impacts with smaller GHG emissions, land use, and water, but at the same time, since it involves activities which are highly processed and request a huge amount of energy, it can also be a threat for the environment. (Tuomisto & Teixera de Mattos, 2011).

This new production system is expected to acquire more attention from companies due to the growth of the demand for protein and the expected failure of traditional meat production, which would allow to create new opportunities (Mancini & Antonioli, 2022).

Shifting to new sectors, plant-based meat can offer opportunities for farmers to diversify or completely change into the production of plants, algae, mycoprotein, seaweed, etc., and, at the same time, to companies by enlarging their offering and their markets (Luiz Morais-da-Silva et al. 2022).

As an example, we can take into consideration the NotCo company, which is a US start-up whose aim is to reinvent the food industry by using artificial intelligence and replicating animal products starting from plants and vegetables. The company offers a few substitutes for animal products, such as NotMilk, NotMayo, NotIcecream and NotMeat, which are the perfect replication and replacement of real meat and animal milk products, produced with less energy, less water and less CO2 emissions. (e.g., NotCo 2022).

However, not all scholars agree on the positive impacts on people and planet of the production of alternative meat. Despite the promising purposes of these products, at the same time, there are doubts about the processing activities of AP, which can be considered as "ultra-processed food" (Monteiro et al., 2019). Indeed, health care institutes recognize that processed food can be linked to some health

issues and diseases such as obesity, diabetes, etc, related to the presence of additives or flavour enhancers.

Moreover, by analysing a study conducted on the effects of the production of cultured meat, (Tuomisto & Teixera de Mattos 2011) it has been seen that, by calculating the energy input of cultured meat, this could be relatively high due to the additional processes involved; however, this high energy consumption could be decreased by adding and improving various technologies.

Table 1 summarises positive and negative aspects of the production of alternative meat.

Table 1. Positive and negative sides of the production of alternative meat.

	Health	***Economic***	***Environmental***
Positive	Benefits that come from the reduction of consumption of meat.	Possibilities for companies to expand their market; possibilities for farmers to enlarge their offering by diversifying or completely changing	Reduction of GHGs
Negative	Ultra-processed food which is doubted to be healthier	Increase in land use in order to grow the inputs necessary	A huge amount of energy used

3.4. A summary of different vegan production systems

In order to answer our RQs, the table below (2) summarises the characteristics of the main three vegan and plant-based productions, which incorporates principles of Circular Economy, Green Economy and BioEconomy in their business models. Other than proper vegan products, it has been important to take into our analysis also the newest production system for cultured meat, which is done by using the same principles of AP products (i.e., bicyclic-vegan products), with the involvement of technologies to recreate protein products and alternatives to the real meat.

Table 2. A picture of different vegan productions

Type	*Description*	*Benefits*	*Categories*
Biocyclic-vegan	excluding materials such as horn meal, blood meal and composted manure from farming in the land cultivation	using natural resources and enabling them to ensure their availability in the future, which means that they do not have to be depleted. it aims to re-establish a healthy life cycle	Algae protein; yeast; mycoprotein
Plant-based	Protein products made from natural resources, alternative to real meat in texture, flavours and aspect.	Eco-friendly, more sustainable, nutritious and healthy and more affordability	Pulses/legumes; Seeds; cereals; Seaweed. e.g. Pea, soy, chia seed etc.
Cultured meat	cellular agriculture and is molecularly identical to conventional meat but produced through bioprocesses from animal cells extracted through biopsies	environmental and health benefits, reduced risk of contamination and foodborne illness, as well as being more ethically acceptable	In vitro cultured meat cells

4 Conclusions

The outcome of our study is an "explanatory journey", which starting from the Circular Economy applications combined with the Green Economy principles, leads to the possibility of thinking new business models applied to vegan companies.

Namely, in this paper we elucidated the concept of circular Bioeconomy, and its applications in order to produce vegan products through biocyclic-vegan production and alternative meat production. Indeed, both processes and technologies are used to produce alternative protein (AP) through sustainable and ecological activities. Furthermore, vegan production impacts on society are directly linked to the goals of SDG12, which consists of responsible consumption and production.

Based on academic and grey literature analyses, our research highlights that:

- The production of vegan alternatives, mostly produced from legumes provide benefits both for the environment and for human health.

- New production technologies and processes may create opportunities for companies to expand their market and increase their economic values.
- The production of alternative meat, based on technological innovations has been demonstrated that is a replacement for real meat products, since it is able to replicate the texture, the taste and nutritional values of meat products, such as beef, pork, etc..
- However, there is still an ongoing discussion about alternative meat and its real effects on the environment and human health, being "ultra-processed" food. To deepen this debate, we deem future research should embed an interdisciplinary approach with inputs from scholars in biotechnology, human nutrition, medicine and management.

In this still gray area, the application of technological and process innovations to business activity must follow principles of responsibility and impact assessment that consider individual and collective, private and public interests. Food production is a key issue for humankind's survival and represents what we call a wicked problem. Our research has not only theoretical implications but also managerial implications for vegan food production which is undergoing a phase of evolution both in terms of technologies and markets.

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Annex 1- Comparison of goals and actions of CE, BE, and GE.

Focus	CE	BE	GE
Goals	sustainable production and consumption following the philosophy of "zero waste". improving social conditions through job creation and regional development	using biomass and reducing the usage of fossil fuels and non-renewable materials and thus, improving social conditions through job creation and regional development	focuses on trade-offs among ecosystem services and across sustainability dimensions with the aim of mitigating climate change and increasing ecological and social benefits.
Actions	Restoration and maintenance of ecosystems; development of nature-based solutions and green infrastructures; zero waste production.	improvement of material and energy performance; product reuse and remanufacturing.	Usage of technology, Innovations to create value goods and services from biological resources; ensuring sustainable sourcing and efficient resource use.

Knowledge as a Circular Resource: Integrating Information Exchange and Circular Business Models for Product-Life Extension

Rasmus Jørgensen*

Copenhagen Business School
Strategy and Innovation
Kilen, 2000 Frederiksberg, Denmark

Enrico Scarso

DTG - University of Padova
Stradella San Nicola, 3
36100 Vicenza, Italy

* *Corresponding author*

Abstract

The change from a linear to a circular business model requires the development of new services integrating information exchange and product usage to prolong product life through maintenance and repair. Information exchange has been identified as important for promoting circular economy, and this study draws on empirical data from a two case studies to demonstrate which kind of information supports maintenance and repair, and how the information exchange can be facilitated. Case company A offered maintenance of white goods (e.g., washing machine) as a subscription service where reminders and maintenance guides were emailed monthly to customers. Company B offered virtually guided repairs of white goods. The study finds that sharing information on what and when to do something facilitates end-users to participate in maintenance and learn about maintenance; more than half of the company A questioned customers reported that they learnt from guides and were involved in maintenance due to guides and reminders. For repair the problem description and possible solutions is information that must be exchanged, and a simple voice and video call can facilitate repairs that prolong product life with a minimum cost for the end-user. Both types of information exchange are facilitated by simple-tech solutions relying on known and cheap technology (e.g., email service, video call, and text-messaging). The findings of the study suggest that the development of circular business models does not always require expensive high-tech solutions to integrate information flow with product flow and usage, and companies are recommended to experiment with designing solutions based on known technology.

Keywords – Circular business models, Knowledge management, Information exchange, Case study

Paper type – Academic Research Paper

1 Introduction

Circular economy aims at reducing energy and material leakage from systems to disconnect goods manufacturing from raw material usage (Bocken et al., 2016; The Ellen MacArthur Foundation, 2013). To promote circular economy within businesses legislators are developing new policies e.g. European Circular Economy Action Plan, with the intent of increasing business focus on product life-time. Focus on product life-time is also promoted by changes in customer awareness and behaviours towards after-sales services to ensure better economic and environmental performance of products (Shokohyar et al., 2014). A circular buusiness model contrasts with a linear business model by prolonging the useful life of product, part, and material through continuous cycles of maintenance, repair, reuse, refurbishing, remanufacturing, and recycling (Geissdoerfer et al., 2020). From a resource perspective maintenance is generally prioritized over recycling because the functional value of the product is retained through maintenance instead of the product being shredded down to its constitutive material through recycling (The Ellen MacArthur Foundation, 2013). Thus, policy and customer requirements change market conditions making the product life-prolonging activities *maintenance* and *repair* impending for companies to develop in the transition from linear to a circular business model.

The efficiency and effectiveness of circular economy is dependent on information exchange spanning intra- and extra-organizationally (Bhatia et al., 2020; Bressanelli et al., 2022; Guldmann & Huulgaard, 2020; Škapa, 2019). However, there is scarce empirical evidence of integration between information management and circular business models (Atiku, 2020; Klapalová, 2019), and the link between information management and the principles of circular economy (Jäger-Roschko & Petersen, 2022). In particular there is limited research on after sales services and product life extension (Islam & Huda, 2018).

This paper addresses the lack of empirical evidence through a multiple case study of two companies; company A sold a service that assisted consumers in maintaining their white goods (e.g., washing machine and dishwasher), and the

case is analysed to inform how information exchange supports maintenance. Company B refurbished and sold pre-owned white goods and it is analysed to inform how information exchange supports repair. Collectively, the cases inform an analysis of how information exchange prolongs product life-time and how information exchange is integrated with a circular business model. The aim of the paper is to develop recommendations for operationalization of information exchange supporting circular economy principles. At this aim, the following two research questions are directive:

1. What information exchanged between a company and end-user can facilitate maintenance and repair?
2. How can the information exchange be facilitated?

2 Theoretical background

Circular business models are an important enabler for companies adopting circular economy practices. A circular business model prolongs product and part life-time through successive cycles of maintenance, reuse, repair, remanufacturing, and closing material loops (Geissdoerfer et al., 2020). To capitalise on circular economy a business must facilitate prolonged usage and capture of product embedded value, and facilitate information management in relation to products (Nußholz, 2018).

Since it is a recent issue, there are limited studies highlighting the interplay between information management and circular economy (Atiku, 2020). Extant studies underline the positive implications for integrating information flows and knowledge management with the circular economy (De Marchi & Di Maria, 2020). However, current information flow practices focus on supporting production and sales of new goods, whereas the information flow in the circular processes dealing with used products is often overlooked (Jäger-Roschko & Petersen, 2022). To increase circularity by addressing barriers of information flow three initiatives are necessary (Jäger-Roschko & Petersen, 2022): i) interorganizational information sharing between business areas like manufacturing and recycling must be improved (often smaller companies lack technology and knowledge to engage in information sharing (Burger et al., 2018)); ii) access to information for all circular economy actors must be facilitated (manufacturers often restrict third party recyclers or maintenance companies access to information (Burger et al., 2018)); iii) incentives for circular economy information sharing must be created. Reducing

barriers for integration of information flow enables end-users to become more proactive actors within the life-cycle of a product and engage in life-prolonging maintenance and repair (Emmanouilidis et al., 2018). User engagement towards acting on the data provided by products is essential for the information flow to have an impact (Mulcahy et al., 2019). The lack of engagement has several sources e.g. engagement of end-users in monitoring power consumption of their refrigerator is inhibited by several barriers; smart plug cannot be installed, instruction guide is missing, and monitoring tools introduce more complexity (Fensel et al., 2017). To increase user engagement, companies must address both the perceived impact in terms of privacy and the ease of use (Kim et al., 2017). Therefore, in the design of after-sales services, like repair and maintenance, user interaction needs and methods for inducing behavioural change must be considered in order to increase engagement (Geelen et al., 2013).

Maintenance and repair keep a product in good working condition and capable of delivering functional value to the end-user, thus increasing the functional value realized over time (Morseletto, 2020). Maintenance of equipment is, in general, a crucial element of keeping a process relying on technical equipment running stable and without unwanted stops. The functional value is maintained by keeping the function available for an end user, e.g. keeping a car running by changing oil, but maintenance can also retain the visual value of a product and thus retain the functional value. Extending the life-time of product is not always a straightforward decision (Boldoczki et al., 2020) and requires assessment of "*environmental benefits/drawbacks of extending the operating time of products that can be achieved due to specific design and maintenance actions, in comparison to their replacement with newer ones*" (Ardente et al., 2018).

3 Research design and methodology

Given the study's exploratory aim a case study approach is adopted (Yin, 2009), analysing information exchange practices of two Danish companies operating in the white goods sector. The case companies were established as circular business models that incorporate information exchange, and were selected by purposeful sampling (Suri, 2011); Company A informed the study of information exchange for maintenance and company B informed the study of information exchange for repair. Access to data were facilitated by the lead author that co-founded both companies.

Case company A was a start-up born circular offering life-prolonging preventive maintenance for white goods and was called FIXRS. The company operated for 3 years (from 2020 to 2022) and assisted the end-user through a virtual DIY (Do-It-Yourself) solution comprising emails, monthly reminders (Figure 12) and video-guides (Figure 13). The reminders and guides were sent monthly and divided in a wheel lay-out, and the guides were accessible via the website and paying customers were emailed the reminders. The reminders were developed as short stories with video, pictures, and text, and the picture in Figure 13 show step 3 in the guide on how to clean the filter of a washing machine. The customers were sent emails and text messages as reminders and containing links to maintenance video guides e.g. on how to remove calcium or clean filters. The company had approximately 70 paying customers at the time it was closed, and the customers were both private and public (e.g. offices with small kitchens). The company closed because the business model was not financially viable.



Figure 12: Overview of maintenance tasks for a year



Figure 13: A still from a video guide in story format

Case company B existed from 2019-2022 and was called SimpleVerySimple (SVS). SVS was a privately owned company established with the purpose of creating a profit by reusing and refurbishing whitegoods and selling them to B2C and B2B. The company had a combined workshop and store near greater Copenhagen, where units were refurbished and sold as pre-owned (see Figure 14). SVS incorporated information exchange between technicians and customers to remotely diagnose problems and complete repairs through virtual guidance of

the customer by the technician. Information exchange on repairs was an effort to reduce the cost of repairs by avoiding transport and to reduce the downtime of the unit. During the 3 years, approximately 3300 machines were processed of which 1100 machines were either reused or refurbished and sold, and the remaining 2200 were recycled at a professional recycling facility. SVS main supplier of raw material (used whitegoods) was the largest Danish retailer of whitegoods, which was supplemented with used whitegoods from various sources. The company was closed as it was not possible to find investors.



Figure 14 – Pictures from the workshop and sales room

3.1 Data collection and analysis

Data was collected and analysed with different methods for company A and B, respectively. Company A had a large uniform customer base that received a comparable service from the company thus a questionnaire approach was chosen to infer general conclusions about the impact of information exchange for maintenance. Company B had limited cases (Situations with information exchange to repair a unit) and each case was considered unique in terms of the situation (Problem and repair) and the customer. The characteristics suited a case approach studying the particularities, contextual factors, and common traits to inform general insight on information exchange for repair.

Data for Company A was collected and analysed as follows:

1. A questionnaire was developed by the lead author. The questions were validated with three independent informants to improve and qualify questions and answers.
2. After the company was closed, the questionnaire was emailed to previous customers asking 3 questions regarding usage and impact of reminders and guide and included an open ended text field with room

for comments. The data informed an analysis of how information exchange impacted end-users to perform maintenance, and analysis of how the guides on conveyed knowledge to the customers. The text field had no stated purpose, and the data was expected to inform a qualitative analysis of the responses.

3. The questionnaire was emailed with an explanatory text and no reminders were sent.
4. Additional supporting data was extracted from the newsletter service used to send and track email reminders to further analyse the impact of reminders and guides using data on how many customers opened the email and clicked a link to a guide. Data from the text message service could not be extracted.
5. The questionnaire data was analysed and corroborated with quotes from the text field.

Data from Company B was collected and analysed as follows:

1. Two paradigmatic examples where a technician solved a problem and completed a repair over the phone were identified.
2. Semi-structured interviews with the technician were performed by the lead author to inform a qualitative based analysis of the successful.
3. Examples to derive findings of general validity were analysed.

4 Results

In the following pages, the results of study are briefly illustrated.

4.1 Company A: maintenance

The questionnaire was sent to 70 previous customers and 31 responded, yielding a response rate of 43% (see Figure 15), and 14 respondents left comments and one respondent choose not to answer question 2. In the text field 9 respondents left positive comments regarding the service in general and two comments that raised the issue about maintenance being difficult to judge the impact of thus reducing the motivation.

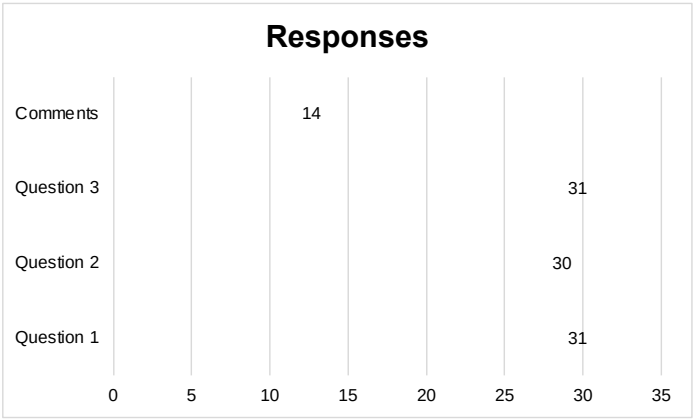

Figure 15 – Response rate

The majority of the respondents (60.3%) affirmed that they to a large extent or complete extent learned something new about maintenance through the guides (See Figure 16). One comment was positive towards the content of the guides e.g. "*For a non-handyman the guides were great*". However, two other comments raised an issue: The character of maintenance and how it fits the end-user's capabilities appear to have an impact, as two respondents left comments on maintenance tasks they were unable to perform, such as moving a washing machine or refrigerator. Exemplified by this quote from a respondent: "*It was demotivating to be reminded of tasks that I could not do for example pulling out the washing machine*".

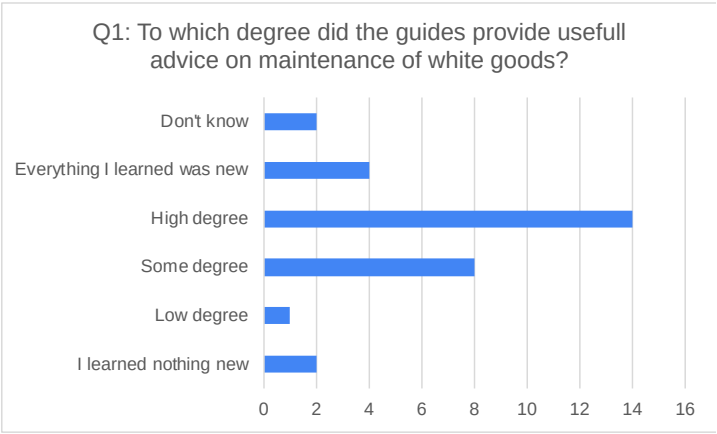

Figure 16 – Responses to question 1

More than half (56.7%) of the respondents considered the reminders to have a high or decisive degree on their behaviour for getting the maintenance done (see Figure 17). This finding is supported by the open text field where 10 of the respondents indicated that reminders were important to get maintenance done, as exemplified by this quote: "*I think the product was great, particularly because I was reminded of maintenance*". One respondent stated that they already did some maintenance, and no negative comments were stated regarding the reminders.

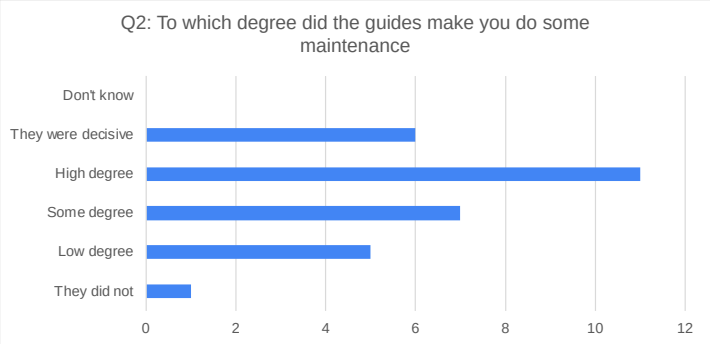

Figure 17 – Responses to question 2

The data from the email service shows a downward trend in terms of reminders being opened and clicked (See Figure 18). When an email was opened it was registered as "open" and a subsequent click on a link to a guide is registered as "click". Data for text messages is not included. Data were tracked for an 8-month period during which few customers were added, and few cancelled their subscription.

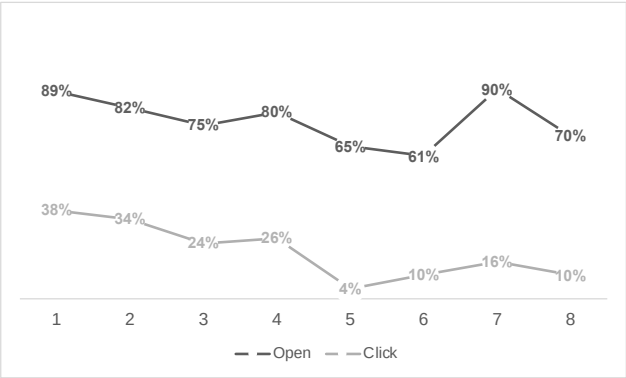

Figure 18 – Data from email service pr. month

4.2 Company B: Repair

Two cases of repair assisted by information exchange were identified with company B. These are examples of small problems that could be handled over the phone and potentially avoid a technician driving out to the customer or the customer scrapping the machine.

4.2.1 Case A: A piece of glass in dishwasher pump

An end-user (customer of the company) contacted the company with a complain regarding a noise coming from the dishwasher when it was running. A call was scheduled between the end-user and the technician. During the first call the technician asked the customer to notice if there was a specific time during the wash cycle that the machine made the noise. A second call was scheduled where the customer informed the technician that the noise came when the machine was pumping water out, and the technician explained the end-user that there probably was something stuck in the pump (e.g. a small piece of glass or porcelain) and instructed the customer to vacuum the pump to remove the foreign object. The customer did as instructed and confirmed over mail that solution worked and solve the problem.

4.2.2 Case B: Lack of cleaning

An end-user complained that the washing machine did not pump water out or was very slow to pump water out. A call was scheduled between the end-user and the technician, and the technician gave instructions on how to clean the pump-filter inside the machine. The filter catches large objects (e.g. coins and hairpins) that enter the machine with the clothes, and if the filter is clogged, that pump takes longer to remove water from inside the machine. The end-user completed the instruction and confirmed that the solution had solved the problem.

In both cases A and B the problem was identified and solved using a simple technical solution that facilitated the conversation between technician and end-user.

5 Discussion

In the following pages, what emerges from the investigated cases is discussed.

The study confirms that information exchange supports circular economy (De Marchi & Di Maria, 2020), and hence that the information flows between actors

must be facilitated, with the case companies acting as facilitators of information. Neither company studied end-user perceptions of the solutions and still managed to support end-users, which provides a different perspective on the necessity of studying user perception before building service (Geelen et al., 2013). One reason could be that the companies relied on proven and known technology.

5.1 End-user information need

The study finds that the information needs of end-users are different for maintenance and repair, respectively. For maintenance, end-users require knowledge about when to do something and what to do, which can be integrated to one information flow where a monthly reminder comprises when and what to do. The information needed can be identified and comprised using existing and available knowledge on maintenance. The findings of the study highlight that end-users have limited knowledge about maintenance indicating the existence of a potential for operationalization of circular economy through reminders of maintenance. For repair the information need is instantaneous, i.e., when a machine stops working, and the needed information exchange cannot be prepared but resides *in situ* with the end-user that must describe the problem, and the technician that must identify and communicate a remedy.

The study finds that the user engagement in maintenance reminders declines over time, demonstrated by the downward trend of emails being opened and clicked. This could indicate that end-users learn and thus are less prone to use the guides which is supported by the 60.3% of the respondents that learned something new through the guides. However, the decline could also indicate a need for feedback on the impact of maintenance to continuously engage end-user (Geelen et al., 2013), something which company A did not provide to their customers. Future studies could explore the user engagement by adopting a longitudinal approach to study barriers and enablers of long-term engagement.

5.2 Simple tech solution

The study finds that simple-tech solutions (i.e., solutions relying on proven and available technology, e.g., email subscription services and text messages) can facilitate information exchange supporting life-prolonging maintenance and repair. Communication from a company to end-users concerning maintenance

can be facilitated by a standard e-mail and text message service, and video guides can be developed using free software. For repair, the solution is more rudimentary; a simple video and voice call service was used. The technologies used by the companies are simple and available at a very low cost, which is in contrast with previous findings, where a low diffusion rate of technology is a barrier for information exchange with high investment costs being a reason for the barrier (Jäger-Roschko & Petersen, 2022). This study places a new perspective on this barrier; there might be a low diffusion rate of technology, but cost is not necessarily a barrier. Instead, a reason for the low diffusion rate could be that companies have yet to develop the services that rely on the technology or perhaps have too grand technological perspectives and thus overlook simple and easily accessible solutions.

The technical solutions identified in this study do not rely on monitoring end-users through sensors; thus, the barrier of privacy is not present (Kim et al., 2017). However, not having sensors makes the advice on maintenance simpler by relying on pre-determined timing on when to do something instead of analyzing data and providing specific advice. This could potentially reduce the impact of maintenance. The findings suggest a potential trade-off between a simple-tech, low-cost, and non-intrusive solution and a high-tech, high-cost, and high-intrusive solution and future studies could address the trade-off and how the different solutions engage end-users.

4 Conclusions: contributions and limitations

Circular business models are important enablers of the shift towards a circular economy, and integration of information flow with the physical product improves efficiency and effectiveness of the business model. There is, however, a lack of empirical evidence for the link between information flow and the life-prolonging activities maintenance and repair (Jäger-Roschko & Petersen, 2022). This study contributes with empirical evidence through a multiple case study aiming at answering the research questions "What information exchanged between a company and end-user can facilitate maintenance and repair?" and "How can the information exchange be facilitated?".

From the academic point of view, the study contributes to the scarce research about the interplay between information and knowledge management and circular economy. The study indicates that the kind of information that has to be

exchanged to support circular economy depends on to the specific nature of the activity involved. The study provides emprical insight on how sharing information on what and when to do something facilitates that end-users engage in maintenance, however, the long-term engagement remains unclear. For repair the problem description and possible solutions is information that must be exchanged when the problem emerges, and a simple voice and video call can facilitate repairs that prolong product life with a minimum cost for the end-user.

For practitioners, the study provides suggestion about the tools that can facilitate information flow and what kind of information to share with end-user to engage them in extending product life.

The study is not without limitations. In particular it is affected by the usual limitations of a case study methodology, and especially the difficult generalization of the results. This paves the way for future research devoted to confirming what emerged from the present analysis, for example, by means of surveys.

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Street-Scale Logistic Hubs for Enhancing Urban Vitality and Public Space Usage

Jesús López-Baeza

Digital City Science
HafenCity Universität Hamburg
Henning-Voscherau-Platz 1 20457 Hamburg DE

Abstract

The article discusses the impact of the trends towards online shopping and personal last-mile micro-mobility on urban mobility and public spaces. These trends reflect changes in consumer behavior and preferences driven by technology and the increasing availability of online services. The article argues that the preference for door-to-door services can potentially lead to a reduction in pedestrian foot traffic and affect the social sustainability of neighborhoods. To address this challenge, the article proposes the use of small-scale transport hubs strategically positioned to cater to evolving consumption and mobility practices, while also preserving the vitality of public spaces and reducing carbon emissions. The article suggests the need for transdisciplinary approaches and digital tools for knowledge management to address the complex challenges of selecting suitable locations for these hubs in cross-cultural settings. The paper proposes a methodology based on digital tools for addressing the clash between general standardized criteria and context-tailored interests in the process of locating small-scale transport hubs, applied for the case study of six European cities to illustrate the methodology.

Keywords – Location finding, micro hubs, geodata

Paper type – Practical Paper

1 Introduction

In recent times, the dynamic and evolving nature of cities and their capability for swift development has become increasingly evident. The global pandemic has further accentuated this phenomenon, as urban environments and societies underwent substantial changes in the way individuals interact with the urban space, as well as in their social conventions and relationships. The changes in consumption patterns and urban mobility offer a telling example of these transformations. Particularly in Western European countries, there are two

phenomena that have radically evolved in the last years: (1) the decrease in physical consumption linked to a rise in demand for online shopping and home deliveries (Beckers et al., 2021; Chava et al., 2022), and (2) the increase in the variety and availability of personal mobility services, including micro-mobility and MaaS solutions that are offered virtually everywhere (Arias-Molinares, García-Palomares & Gutiérrez, 2022).

These two phenomena are related in the sense that they both reflect changes in consumer behavior and preferences that are influenced by technology and the increasing availability of online services. As people increasingly rely on online shopping, they are less likely to visit physical stores and engage in traditional forms of shopping that involve traveling to different locations, when traveling to locations is less cost-effective than receiving goods at home (Kickert et al., 2020). This phenomenon is especially relevant in mid and low-density urban environments where the 15-minute city principles are not applied, and therefore physical consumption requires a considerable amount of effort (Istrate et al., 2020). In parallel, the increase in the variety of available personal mobility services also reflects consumer preferences for more flexible and convenient ways of transportation that enable door-to-door. Again, the newest transportation options (personal last-mile micro-mobility) are sometimes the most cost-effective choices over public transportation (waiting times, walking to stations), car transportation (finding a parking spot), or even walking (slower) (Wang et al., 2023). The positive effects in congestion and emissions reduction are visible as the modal share of private cars is being reduced and bikes and e-scooters are on the rise.

These two trends are characterized by the rationalization of economic choices in consumption behavior (e.g. preference for using a food-delivery app over traveling to a restaurant and waiting for the food, as the most cost-effective option). Nonetheless, the pragmatic implications of such rationalized consumption choices can be witnessed in the realm of urban mobility dynamics, which unfold in public spaces. Therefore, it is of paramount importance to take into account the ramifications of these two trends for public space. In doing so, one must acknowledge that the trend towards door-to-door mobility and logistics may precipitate a reduction in pedestrian foot traffic. For instance, Wang et al., (2023) report that modal displacement of micro-mobility (e-scooters as an alternative to other modes) coming from walking at a rate of 60% in Oslo, and 80% in Munich, and they find a statistically significant and positive correlation

with population density, presence of mixed-use areas and commercial areas, street connectivity, and land-use entropy.

The preference for the convenience and comfort of door-to-door phenomena among individuals presents a significant concern in terms of pedestrian foot traffic, which is directly related to the social sustainability of neighborhoods (Mateo-Babiano & Ieda, 2007; Asif et al., 2022). Should this trend continue, there is a risk of a reduction in pedestrian activity, thereby posing a potential threat to public spaces detrimentally impacting their vitality and liveliness, causing a loss of social cohesion and hampering the development of community identity. The link between pedestrian flow and urban vitality is well-established, as the presence of an active pedestrian environment is indicative of a lively and thriving urban area. Compact urban areas, which provide a greater concentration of destinations within a smaller area, are especially conducive to pedestrian activity, as they offer easy navigation on foot (Berghauser Pont, Stavroulaki & Marcus, 2019). In mid- and low-density areas where the concentration of destinations and general complexity may be lower, any changes in the volume of pedestrian flow would be more significant and could have a more substantial impact on social sustainability in terms of public space vitality, community identity, and social cohesion.

1.1 Micro-hubs for urban vitality

In light of this, contemporary urbanists are working towards developing and implementing innovative solutions that can cater to the evolving consumption and mobility practices. One such example is the exploration of small-scale transport hubs to facilitate mobility and freight transportation while also preserving the vitality of public spaces, and reducing carbon emissions. The "micro-hubs" are small logistic centers based on a two-stage delivery system, where consolidation of cargo and re-distribution into smaller vehicles or self-pick-up are integrated (Hribernik et al., 2020). The successful implementation of these micro-hubs requires strategic positioning based on the social and geographical features of the urban fabric, along with the integration of supplementary services.

The concept of small-scale logistic hubs has gained increasing attention as a solution to the challenges posed by the growing trends described above. The currently existing methods for selecting a location to host a micro-hub for logistics are reviewed by Novotná et al. (2022) based on the problems considered. While the most common methods BWM, CRITIC and WASPAS have already

assessed distribution, energy, and traffic problems, there is currently no established standard set of variables for selecting a suitable location for such hubs that maximizes its positive social sustainability outcomes. This is a complex challenge, particularly in cross-cultural settings where multiple factors influence policy priorities, understandings, and goals.

To address this challenge, transdisciplinary approaches and digital tools for knowledge management must be explored. This paper proposes a methodology based on digital tools for addressing the clash between general standardized criteria and context-tailored interests in the process of locating small-scale transport hubs. The approach considers the unique social conditions of a local context while also incorporating general goals and replicable processes. This contribution highlights the need for transdisciplinary approaches and digital tools for knowledge management to address the complex challenges of selecting suitable locations for small-scale logistic hubs in cross-cultural settings.

2 Methodology

Case study selection: The cities of Oslo, Gothenburg, Hamburg, Munich, Bologna, and Rome were chosen for this study. These cities represent different regions in Europe, providing a broad understanding of urban environments across different contexts, which allows for a more comprehensive analysis of the effectiveness of various urban strategies, and their applicability in different settings.

Data sources: This study utilizes various open-source data formats. To calculate urban accessibility, walkability, connectivity, and street network parameters, space syntax is employed on the street network of the cities, downloaded from OpenStreetMap (OSM), and processed through OSMnx (Boeing, 2017). To determine morphological characteristics of the areas, such as ground floor built density, OSM building polygons are utilized. Additionally, POI (point of interest) data from OSM, such as restaurants, cafes, and offices, are used to calculate the number amenities in urban spaces.

Spatial aggregation: Using this data, virtually available in any city, a methodology was developed to analyze urban areas and identify suitable locations for transport hubs. This method involves merging data from various geospatial formats into a grid of cells of equal size. During the merging process, statistical analyses are performed, including counting the number of items,

calculating item density, and computing average values. This results in a set of metrics for each cell of the grid.

Metrics calculated: Once the data is aggregated by the grid cell, a series of metrics are calculated (Table 1). Those metrics make it possible to compare characteristics of the richness of places, their diversity, their degree of connectivity to the rest of the city, their perceived compactness, and the relevance of their spatial clustering.

Table 1. Description of the metrics calculated.

Metric	Variables	Calculation method
Ground-floor coverage Source: OpenStreetMap buildings Shape type: polygons	Ground-floor coverage ratio	Ratio of ground-floor built area divided by cell area, expressed in %.
Street network configuration Source: OSMnx (Boeing, 2017) street network data input for SpaceSyntax (Hillier et al., 1976) Shape type: lines	Urban integration: relation between one space and the rest of the city	Angular integration with infinite radius (Hillier et al., 1976) normalized by street segment length in each cell.
	Local Integration: relation between one space and adjacent spaces	Angular integration with radius 3 (Kim & Penn, 2004) normalized by street segment length in each cell.
	Walkability: relation between one space and adjacent spaces, at a walkable distance	Metric segment analysis with radius 300m (van Nes, 2021) normalized by street segment length in each cell.
Activities, amenities, and services Source: OpenStreetMap points of interest Shape type: points	Number of places (also referred to as density of activity)	Counting the number of points contained in each cell.
	Number of unique categories of places (also referred to as richness)	Aggregating the place types (Cerrone et al. 2018) by general category, and counting the number of unique categories contained in each cell.
	Diversity indices applied to the number of places and categories (also referred to as entropy or complexity)	Gini-Simpson: detecting rare categories Inverse Simpson: measuring the impact of rare categories Renyi-entropy (alpha value =2): detecting rare dominant categories Shannon: detecting changes in categories richness and evenness Shannon-Wiener: comparing diversity among multiple samples Simpson: detecting dominant categories
	Spatial clustering of	Local Moran's I: Clustering type of

	places	clusters and outliers Local Moran's P: Significance of clustering
	Spatial clustering of each specific place category (consumption, workplaces, third places, leisure, etc.)	Getis-Ord-Gi* Z: Critical value Getis-Ord-Gi* P: Significance of clustering

Standardization: To facilitate comparison across metrics (e.g. built density vs street integration of an area), the scales of each type of metric are standardized. To achieve this, percentile rankings are computed for each metric, considering the minimum and maximum values of each city.

Standardized Value = Percentile Rank = (number of values below the given value / total number of values) x 100

Figure 1: Percentile rank where the given value is the value for which the percentile rank is being calculated. This formula is used to determine the percentage of values in a dataset that falls below a given value and express it as a percentage.

Scenario definition: In order to develop a tailored strategy for each case study city and scenario, co-creation workshops were conducted as part of the Horizon2020 project "MOVE21". The outcome of those workshops made it possible to explore scenarios that align with the priorities manifested by local stakeholders. These priorities are subsequently translated into a weight index ranging from -1 to 1 (negative values indicated characteristics that should be avoided and positive values represent characteristics that should be maximized). Acknowledging the significant direct correlation between the factors that Wang et al. (2023) reported in micro-mobility usage rates, one could argue that two scenarios necessary to explore would represent the ends of the spectrum ranging from compact city centers to disperse suburbia. Therefore, this work takes those two scenarios to test the data pipeline methodology. In the future, the method described by Novotná et al. (2022) could be applied to determine the weights that define each scenario.

Scoring: Once the weights are applied, a weighted average of all metrics is computed for each cell. This results in a single suitability value for each cell, which represents its suitability for the hypothetical scenario set for that city. Overall, this methodology provides a standardized approach to analyzing cities and

identifying suitable locations for transport hubs, while also allowing for tailoring to the unique needs and scenarios of each city.

$$\text{Scenario Score} = \text{Weighted Average} = (w1 * x1 + w2 * x2 + \ldots + wn * xn) / (w1 + w2 + \ldots + wn)$$

Figure 2: Weighted average where w1, w2, ..., wn are the weights assigned to each variable, and x1, x2, ..., xn are the corresponding values of each variable. The weighted average provides a representation of the data by giving more importance to the variables with higher weights, and less importance to those with lower weights.

3 Results

The results of this research depict socio-spatial characteristics that are deemed important for future consideration and analysis. The results also provide a broad city-scale narrative that can be used to understand the research findings at a neighborhood scale. Moreover, the methodology itself has the potential to reveal patterns in the data and highlights the importance of considering both urban and local scales in understanding the functionality of small-scale public open urban spaces from both social and spatial perspectives.

3.1 Ground-floor coverage

The density of built spaces is an important aspect of urban spaces, as it has been shown to be connected to the social fabric of the environment. According to Jacobs (1961), a dense urban environment is more engaging and attractive to people, particularly in terms of building types. Having a high ground floor density might indicate that the areas are built with a more human scale, narrow streets, multiple building fronts, and ground floor activities such as retail.

In most cases, we find these areas in the most central locations of the city, likely to be the historical city center and in close proximity to a central station, to combine residential types with commercial uses. On the other hand, the lower density tends to likely consist of purely industrial fabric or residential single-family suburbs. In the mid-range, we find modern-era fabrics with large building fronts and extensive green spaces in between – in both cases showing a low mix of diverse building types.

Despite the different nature and size of the case study cities selected, one can observe a general trend in which the majority of urban areas contain a low ratio

of coverage, concentrating the highest ratios in specific areas (city centers) or specific points (industrial facilities or shopping malls). In order to compare across cities of different sizes, the aforementioned standardization process is deployed. As a result, we can observe the relative distribution of the ground-floor coverage ratio across cities. The distribution of Gothenburg highlights the presence of a large number of low-density areas, while Bologna and Munich show the highest relative numbers of high-density areas. The cases of Hamburg and Rome show a similar trend in which mid-density areas are more common than in the other cases (e.g. Figure 3). In all of the cases mentioned, a gradient of density can be observed, from the generally most common low density to the less common high density. In the case of Oslo, this gradient is rather an abrupt leap between low and high density, being low-density areas the most common.

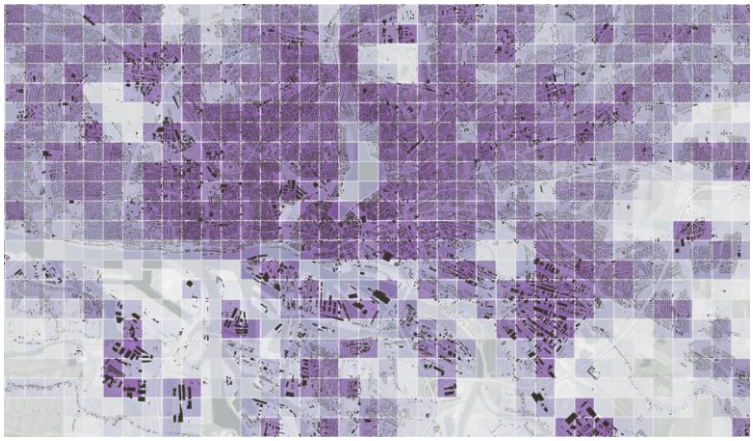

Figure 3. Map of ground floor density in Hamburg, Germany. (Cell size: 600x600m) (Source: authors)

3.2 Street network configuration: connection to other spaces

Assessing potential footfall and traffic flows in a city depends notably on the significance of street segments within the network of streets. The relevance of certain streets over others in terms of connectivity can be determined by using Space Syntax and Segment Analysis, which provide quantifiable metrics to define the spatial role of streets and street segments in the entire urban network. Integration is computed to analyze street networks at both urban and local levels (the number of turns required to reach all other street segments from each segment; a higher Integration is achieved when maximum segments can be

reached with minimum turns). Integration is usually used to "predict" pedestrian and traffic flow, as turns are believed to create cognitive resistance in the network and indicates how well-connected a space is to the rest of the city. Therefore, locations in proximity to highly integrated streets are more accessible, which can be deemed as a favorable aspect for micro-hubs (Barros et al., 2006; Leccese et al., 2020).

In order to transfer the linear metrics of space syntax into the surface covered by a grid cell, the linear metrics are normalized by distance multiplied by the area covered by each cell. Similarly to the ground-floor coverage metrics, the space syntax results are also standardized across cities enabling comparison. In absolute numbers, the city of Rome shows integration values ten times higher than the city of Hamburg. However, when we observe the distribution and location of more integrated streets, we find certain commonalities, such as the higher integration values in the areas closer to the city centers because of the tendency to present a dense and complex urban fabric with narrow and short streets with multiple intersections and corners, compared to suburban fabrics. In this context, Oslo, Gothenburg, and Hamburg present a similar structure in which the majority of walkable areas are found in areas of mid-density, in contrast to Munich, Bologna, and Rome where the most walkable streets are located in the densest areas. In the cases of Oslo and Gothenburg, the metric of integration shows isolated high values that coincide with the presence of isolated areas of high density corresponding to shopping malls, big box strips, and large industrial areas that are located next to highly connected roads (Figure 4).

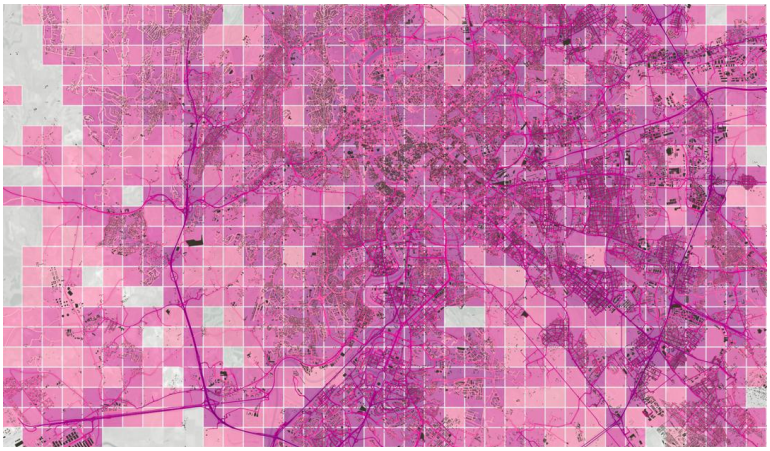

Figure 4. Map of street integration in Rome, Italy. (Cell size: 600x600m) (Source: authors)

3.3 Activities, amenities, and services

Previous literature has explored the activities that take place within the urban space, with a focus on the primary function of the places, their adherence to normative land-use categories, or their significance in daily routines and necessity levels. Scholars such as Seamon (1979), Buttimer and Seamon (1980), Gehl (2011), Ben-akiva and Bowman (1998), and Jiang, Ferreira, and González (2012) have delved into these topics. Cerrone et al. (2018) utilize these references to develop a classification of urban activities based primarily on the need for action, as proposed by Gehl (2011), aiming to encompass all types of activity in the city regardless of the specific space in which they occur. They apply it to Foursquare POI datasets. From an urban-social standpoint, the distribution of activities (or functions) is approached based on its ability to influence pedestrians. If functions are segregated or concentrated in specific areas, this can limit spontaneous choices, serendipity, and randomness. Such segregation can also lead to an increase in motorized traffic modes and subsequent congestion, as multi-purpose trips would require traveling to different parts of the city beyond a walkable distance threshold. This would also reduce temporal entropy, resulting in areas of the city being visited by people at the same times of the day, creating temporal-activeness imbalances and traffic congestion during rush hours (e.g. people leaving downtown at the end of the workday). In contrast, areas with a higher mix of functions, such as residential, commercial, and services, offer more sustainable everyday dynamics, are more walkable, and align with the 15-minute city approach (Balletto et al., 2021). These areas also provide opportunities for serendipitous interactions, making the neighborhood more interesting, as Walking the Walk (2009) suggests. For this reason, this work approaches the distribution of functions as the key factor to define whether an area will potentially be benefited from the presence of a micro-hub.

Using the POI database of OpenStreetMap, it is possible to evaluate the presence of amenities, services, and functions in urban space (hereafter, activities). In this contribution, we focus (1) on the overall presence of activities per unit of area in order to notice their degree of concentration, and (2) on the presence of diverse types of activities in order to evaluate the degree of mix. In order to do so, ecosystem entropy evaluation methodologies can be implemented to assess the degree of complexity of activities in a given urban area. In our case study cities, there is a partial correlation between the ground floor density and both the

density of activities, and the diversity of types; the most complex areas are those with higher ground floor density such as the city centers and isolated shopping malls. However, not all highly-dense areas are also complex, since industrial areas appear as dense but only host one type of function thus a low complexity index (Figure 5).

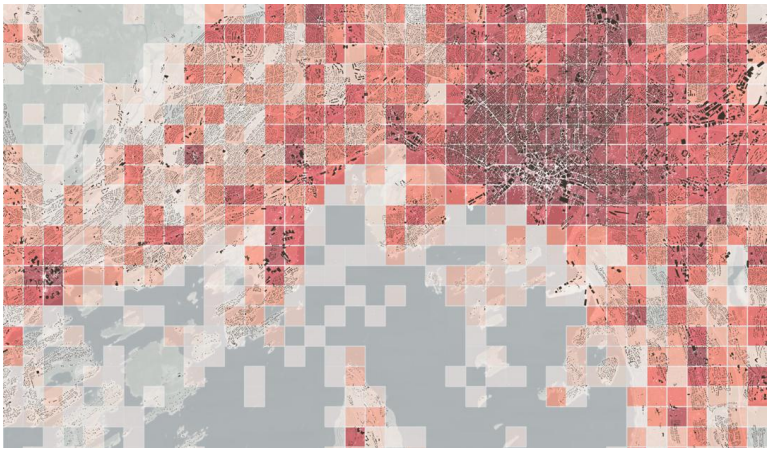

Figure 5. Map of POI diversity (Shannon-Wiener) in Oslo, Norway. (Cell size: 600x600m) (Source: authors)

3.4 Scenario definition

In order to define scenarios in which to assess the feasibility of an area to host a small-scale transport hub, co-creation sessions were carried out in the context of the European Horizon 2020 project "MOVE21". In these sessions, stakeholders in a quadruple helix setting (public authorities, research institutions, private companies, and proxies for citizenship) discussed (1) the existing problems that a space might have, that a transport hub could solve, and (2) the ideal spatial conditions that a space should have for hosting the implementation of a such transport hub.

Considering the overall goals of reducing traffic and carbon emissions, as well as increasing the presence of people in public spaces, two main scenarios were considered. This first scenario takes advantage of an existing consistently high level of pedestrian flow and introduces a micro-scale transport hub in an area that is dense, walkable, popular, and has a high density and diversity of activities. By doing so, a convenient location for collecting small parcels would frequently be on the way from one place to another, being subject to multipurpose trips at a

walking distance instead of a targeted trip in a longer distance potentially using a vehicle. In this context, metrics of ground-floor converge ratio, the density of activity, complexity, and walkability have a heavier weight in this scenario.

The second scenario poses a situation in which an area with a low ground-floor coverage ratio, low density of activity, and low complexity is highly accessible to motorized traffic (e.g. single-family residential fabrics). In this case, the presence of a small-scale transport hub would include additional functions with the intention of creating a "neighborhood hub" that attracts people. By doing so, the transport hub in the second scenario is intended to activate the social fabric of these areas. In this context, the metrics described in the previous scenario would have an inverse weight, while integration at infinite radius would be heavier.

By applying the weights to the indicators and computing the weighted average, one score (from 0 to 100) is given to each cell in the urban grid, for each scenario. The score represents the suitability of that individual cell to meet the requirements of the scenario, and is therefore a recommended location to establish a small-scale transport hub (Table 2, Figure 6).

Table 2. Summary of the number of cells matching the scenarios defined by the stakeholders over 99/100.

City	**Total number of cells (100%)**	**Cells scoring over 99/100 in scenario 1**		**Cells scoring over 99/100 in scenario 2**	
Oslo	4047	5	0,12%	4	0,10%
Gothenburg	3654	4	0,11%	4	0,11%
Hamburg	3965	5	0,13%	5	0,13%
Munich	1140	3	0,26%	3	0,26%
Bologna	483	1	0,21%	1	0,21%
Rome	4224	6	0,14%	5	0,11%

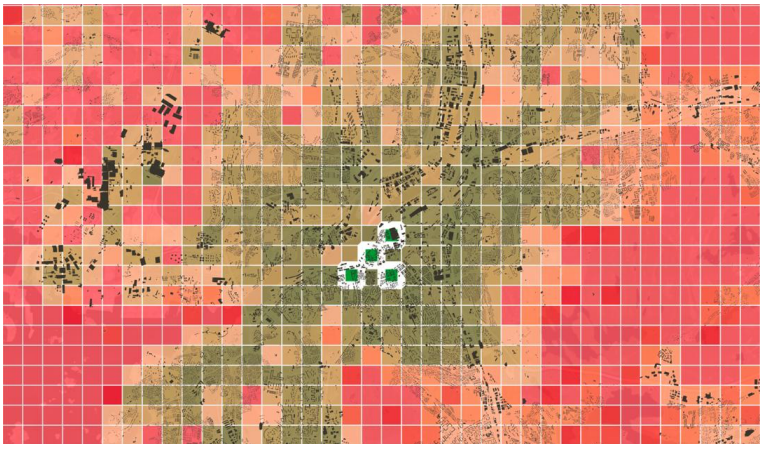

Figure 6. Map of cells scoring 99/100 in Scenario 1 in Gothenburg, Sweden. (Cell size: 600x600m) (Source: authors)

4 Discussion

The methodology presented in this paper could be a valuable tool for narrowing down possibilities and evaluating the suitability of different areas for finding the location of a small-scale logistic hub. In addition to its effectiveness in location finding, the methodology has provided insight into the correlation between different factors and their impact on urban environments. The results have confirmed that city centers are generally the most suitable locations when looking for dense, diverse, and vital urban areas. In addition, the methodology has also provided quantitative information on specific areas within those centers at a micro level (specific plot, or building), that may be more suitable for certain purposes.

Interestingly, the methodology has revealed surprising similarities in correlations across different case study cities, despite differences in size, cultural context, age, and form. By quantifying these correlations, the methodology has allowed for a deeper understanding of how different factors impact urban environments. For instance, it has been shown that density and functional clustering works similarly in large and isolated shopping malls than in dense city centers.

In general, it is possible to observe correlation across the metrics that are grouped in the three variables of ground-floor density, street network integration, and presence of amenities and services (Figure 7). In general, one can distinguish dense integrated areas that are rich in services from low-density isolated and

disperse areas. Furthermore, in all six cities, one can observe the same ratio of areas with a statistically significant concentration of amenities and services (between 25% and 28% of the areas in the city show statistically significant concentrations).

However, the correlation across metrics is slightly different in our case study cities and establishes two groups. The northern cities are more spread, and the southern cities are more compact, and compact areas are surrounded by sprawl. This grouping is reflected by characteristics such as:

- The correlation between ground floor density and urban complexity is higher in compact cities than in large mid-density cities: (1) over 75% correlation between density and complexity in Munich, Bologna, and Rome showing high-density city center and low-density suburbs, with amenities clustered in the dense area, and (2) under 68% correlation in Oslo, Gothenburg, and Hamburg showing lower built density in the city centers and higher density in the suburbs than the previous group, with amenities spread relatively equally.
- Integration (both infinite radius and walking distance) and urban complexity are correlated under 60% in Oslo and Gothenburg, between 60% and 70% in Hamburg, and over 70% in Munich, Bologna, and Rome. This factor underlines again the greater divide between dense areas and suburbs in the second group, versus a more homogeneous urban fabric in the first group.

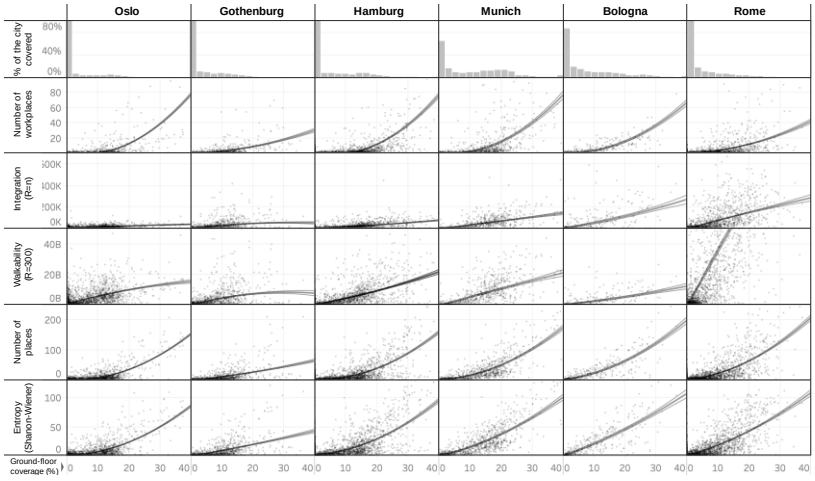

Figure 7. Scatter plot showing the correlation between ground-floor coverage and other variables in the six cities. Source: Authors

With this in mind, the methodology presented in this contribution offers the potential of tailoring specific strategies to a certain context while keeping a standardized thus replicable course of action. In relation to the specific use case of location finding for micro-scale transport hubs, the observations about the divide between urban and suburban in the group of compact cities might offer insights about the values worth maximizing, when designing a location finding strategy based on multi-criteria weighted analytics.

Once each area of the city receives a score that represents its suitability for a given list of priorities, one can: (1) select a location in the city based on the results of the scoring, or (2) evaluate the suitability of a given area in the city, compared to all other locations. For instance, the location of such service in a low-density residential fabric with a general absence of other services could create pedestrian flow around a catchment area of walkable distance. If such space is wanted, one can prioritize low density of buildings, amenities, services, and a low index of integration within a walkable radius to highlight the areas in the city that would benefit the most from such intervention. Similarly, a micro-scale transport hub would maximize its uptake by the end user in an area that is dense, walkable, and has other destinations. The trip to collect a package, for instance, would be most likely included in a scheme of multiple destinations thus avoiding the generation of additional trips (if by car, reducing traffic). From a governance and decision-making perspective, the choice of a location would be depending on the desired impact, which can be given as weights to the multiple factors described in this contribution. Additionally, the pipeline focuses on data standardization and comparison, being adaptable and scalable to include different data.

In general, these findings suggest that the spatial arrangement and characteristics of urban areas can significantly influence the relationship between factors, highlighting the need for a nuanced understanding of how these variables interact. Overall, we believe that the methodology presented in this contribution has the potential to significantly impact urban planning and design by providing a data-driven approach to evaluating and improving urban environments.

4.1 Limitations and further development

The data used is often very general, and the results are limited to the scale of 600x600 tiles, which can limit the level of detail that can be achieved. A deeper

understanding can be gained by looking at more specific areas, but this must be balanced with the computational power required to do so. Additionally, the results only provide an overview of a city from a strategic perspective using open data with general information, and may not be useful for more specific discussions that might need the proper level of detail in the data. Further development of this tool may involve incorporating more detailed datasets and exploring the use of other statistical measures to provide a more holistic and detailed understanding of urban spaces.

Regarding the definition of the scenarios, this work assumed two test scenarios (compact urban space and disperse suburban areas) in order to test the data pipeline and the suitability of the application to maximize potential social sustainability outcomes. However, further development should include standardized methodologies for establishing the weights of the multi-criteria assessment. The Hybrid BWM-CRITIC-WASPAS model described by Novotná et al. (2022) could be applied to determine the weights that define each scenario, considering the criteria described in this contribution.

5 Conclusion

In conclusion, the use of data-driven approaches, such as the one presented in this study, can support decision-making processes related to the location selection. By selecting an area that maximizes the outcome that decision-makers decide, the implementation of this approach can provide quantitative proof to justify the location selection, streamlining the process. Moreover, this approach enables knowledge sharing in an inter/trans-disciplinary context, involving several stakeholders with different interests. Additionally, the weights used in this study can be easily adapted for different scenario definitions, further enhancing its applicability. Overall, this study demonstrates the potential of data-driven approaches to provide strategic insights for location selection, and it can be a valuable tool for decision-makers in various fields.

Our research methodology involves the use of three different approaches: (1) a morphological description of ground-floor density distribution (2) a network-analysis-based approach that identifies which streets are more likely to host flow; (3) a functional classification of places and activities with an interpretation of the distribution of places and types of places. This approach outputs a comprehensive pre-selection of places to host a small-scale transport hub. This pre-selection

comes from an understanding of some relevant socio-spatial characteristics of urban areas, allowing for an informed assessment of the potential likeliness to reduce carbon emissions by nudging the modal shift towards walking while keeping urban spaces vital.

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Building a Knowledge Management Cooperation Model through TOSCA as a Digital Tool for Urban Development

Arjama Mukherjee*

HafenCity University Hamburg
Henning-Voscherau-Platz 1,
20457, Hamburg, Germany

María Moleiro Dale

HafenCity University Hamburg
Henning-Voscherau-Platz 1
20457, Hamburg, Germany

Jörg Rainer Noennig

HafenCity University Hamburg
Henning-Voscherau-Platz 1
20457, Hamburg, Germany

* *Corresponding author*

Abstract

This paper analyses the different adaptations of TOSCA, an open-source geographical information system (GIS) toolkit to different urban contexts across the world and the learnings through these adaptations; involving the synthesis of extracted knowledge, its translation and final adaptation into a location-customised tool for decision-support in the context of planning. Knowledge management and extraction methodologies developed and adapted in the process of implementation of this toolkit in India, Ecuador and Palestine provide insights into the application of digital tools for urban planning and contribute to the streamline of knowledge extraction mechanisms across different cultural contexts.

TOSCA, or Toolkit for Open and Sustainable City Planning and Analysis, has been developed since 2019, between the HafenCity University Hamburg (HCU) as research partner and the German Agency for International Cooperation (GIZ) GmbH as funding partner, to develop strategies and tools for sustainable urban development in two initial pilot locations _India and Ecuador_ and from 2022 in Palestine; for each case involving additional local cooperation partners. The tool was conceptualised as an open-source, easy-to-use and scalable tool for accessing complex urban analyses, as a solution to the

fact that GIS tends to be an expensive, complex and inaccessible software for many rapidly urbanising contexts with low resources.
The three contexts of India, Ecuador and Palestine presented vastly different urban challenges and actors, which required the customization of a tool development process to carry out the implementation of the project in each location. Necessary steps involved the identification of pressing issues, the definition of a relevant use case, the identification of roles and mobilisation of the local stakeholders, tool adaptation, technical revisions and knowledge transfer for its sustainable take-up.
After understanding the outcomes of the three past implementation projects, a model of ideal cooperation for knowledge management emerges as a potential way to systematise the methods for gathering knowledge and rendering it applicable to different scenarios. The identification of four fundamental agents in this model emerge, according to their roles and produced effect in the development process for TOSCA: (the funding agent) dissemination of means for sustainable development, (the R&D agent) incorporation of digital technologies in urban systems, (the local institution agent) consolidating local capacity building and (the local authority agent) public outreach and uptake activities. TOSCA, as a tool intended to contribute to sustainable growth in urban regions, lies at the intersection of these four roles, which are codependent on each other in different ways.
The objective of this paper is a first approximation to the exploration of this model as a potential solution for knowledge management and dissemination of a toolkit such as TOSCA.

Keywords – digital planning tools, open source, GIS toolkit, city science, knowledge management, decision-making

Paper type – Academic Research Paper

1 Introduction

In an Era of rapid urbanisation, especially in the Global South, it is expected that 90% of the rise of the world's urban population will take place in Asia and Africa. (UN, 2018). This estimation highlights the urgent need for revision of processes adopted by policy-makers to address sustainable urbanisation (Moleiro, M. et al., 2023).

In order to mitigate the effects of urban sprawl resulting from rapid urbanisation, effective measures are required. Information and Communications Technology (ICT) is playing a pivotal role to replace traditional methods and services, pushing governance into a new dimension, and is focussed on the use of data and data-driven tools for enhancing exchange and transfer of information (Moleiro Dale,.M. and Mukherjee, A., 2022). In this context, digital planning tools

based on geographic information systems (GIS) can be game-changers for spatial analysis for faster decision-making and participation in urban planning processes.

The Toolkit for Open and Sustainable City Planning and Analysis (TOSCA) was developed in 2019 by the HafenCity University (HCU) in cooperation with the German Agency for International Cooperation (GIZ) to develop a web-based, open-source GIS tool to be used on a multi-touch table or browser technology. It was piloted in the cities of Bhubaneswar (India), Latacunga (Ecuador) and in the Palestinian regions between 2019 to 2023. Conceptualised and designed as a scalable, low-cost and low-tech solution (Moleiro Dale,.M. and Mukherjee, A., 2022), TOSCA was built to address identification of land for affordable housing in India, to adopt volcanic-risk governance strategies in Ecuador and to build a citizen participation tool for the Palestinian regions. The implementation of TOSCA in the three contexts led to the emergence of a knowledge management model to address challenges for sustainable urban planning and decision-making for integrated urban development. A key challenge in the process was the creation of explicit knowledge from tacit knowledge, comparable to creating concrete technical solutions from wider, general urban challenges.

The focus of this paper is to understand the role of TOSCA in translating tacit knowledge to explicit knowledge through the development and adaptation of the tool to address different use-cases in the area of urban development. Several methods and tools were adopted for this purpose which is elaborated in section 3.

2 Background

Tacit knowledge refers to knowledge made up of judgements, know-how and other skills. Usually, it refers to knowledge difficult to articulate or codify. Explicit or codified knowledge on the other hand, is knowledge that can be written down in a form which allows others to understand and reproduce (Gamble, J.R., 2020).

The Nonaka and Takeuchi knowledge management model is based on the concept of knowledge creation and refers to a cyclical process involving four different modes of knowledge conversion namely, socialisation, externalisation, combination and internalisation.

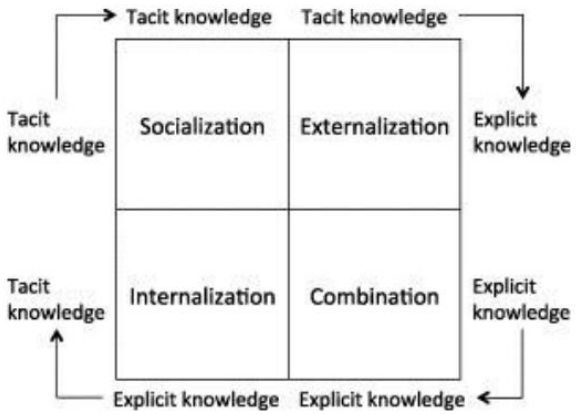

Fig. 1. The Knowledge creation process according to the Nonaka and Takeuchi model (Anggraini, A., 2018)

Socialisation refers to the modification of tacit knowledge to other types of tacit knowledge and includes sharing experiences, images, ideas among others. It usually takes place through joint activities, observation, imitation and practices instead of through written instructions. Externalisation is the conversion of tacit knowledge to explicit knowledge, that is, hidden tacit knowledge like concepts and ideas are converted to a comprehensible format. This may include computer-based techniques like visual modelling, machine learning methodologies, etc. that are able to support individuals to express an inherent conceptualisation. Combination refers to explicit knowledge conversion into more complex sets of explicit knowledge. Finally, internalisation refers to the extension of explicit knowledge to tacit knowledge. These processes usually produce experience knowledge through an explicit knowledge source (Dakoulakis, I.E. et al. (2004)).

In urban planning, tacit knowledge plays an important role in collecting and identifying urban challenges, such as identifying key issues within different realms of society and potentially contributing to generate hypotheses about relational factors. Such information is often not apparent or available from explicit data sources such as maps or census data.

It is of crucial significance to be able to communicate and transfer such tacit knowledge in a way that is understood by other stakeholders involved in a planning process. Given the spatial significance of urban planning, usually visualisation, diagrams and models are a good way to represent tacit knowledge to make it easily communicable and actionable.

Often, tacit knowledge in urban planning refers to non-spatial information that may refer to strategies, visions, opinions, observations that may not be easily captured. However, such knowledge is essential to consider for effective decision-making and inclusive urban policies and interventions. Spatial information can be classified as a type of explicit knowledge because it can be visualised, stored and communicated in a formalised and structured manner. Spatial data such as maps, satellite imagery and geographic information system (GIS) data can be represented using different digital formats that can be further shared and analysed.

Translating such non-spatial information to spatial information is a critical aspect of the usefulness of tools like TOSCA to support decision-making in urban planning processes.For the implementation of TOSCA, translating knowledge from city partners onto a technical solution to address identified issues was significant. The biggest challenge in the implementation of such a tool was to collect tacit knowledge from partners in each location and to identify adequate methods for its translation into explicit knowledge that could ultimately be applied through a GIS system , enabling further dissemination through concrete documentation and knowledge transfer.

3 Knowledge building and management tools

The approach for implementing TOSCA was an interactive and non-linear process that allows understanding the user, challenges assumptions, redefines problems and creates innovative solutions that can be prototyped and tested, inspired by design thinking (Dam, R.F. and Siang, T.Y., 2023). In such a process, engagement with several different cognitive processes are required that include preparation, assimilation and strategic control (Razzouk, R. and Shute, V., 2012). The following tools and methods were used in the implementation of the knowledge management of TOSCA to facilitate creative design activities such as use case definition, user requirement analysis, conceptual design, prototyping, testing and implementation by way of the design thinking approach.

For all pilot locations, the applied implementation methodology carried out was similar and was adapted to specific contexts (Moleiro, M. et al., 2023). As seen in Fig. 2, it consisted of a demand and requirement analysis with local partners, workshops with users and administrators, development of the software and performance of usability tests to identify technical challenges for improvement.

The tools and methods described in the next sections have been integrated into the implementation methodology to highlight the phases in which they were used.

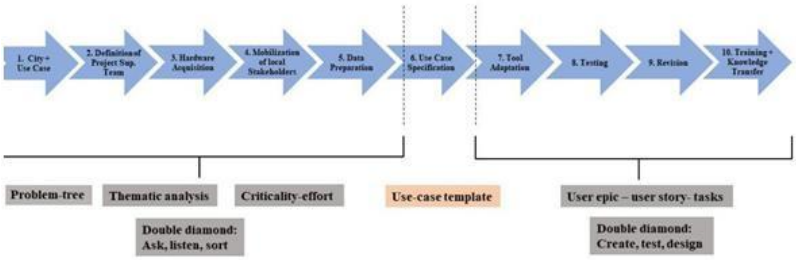

Fig. 2. The integration of the different tools and methods used along the implementation process of TOSCA (Digital City Science, HafenCity University Hamburg)

3.1 Use case template

A use-case may be defined as a description of ways in which a user interacts with a system or a tool and accomplishes a goal. By defining a specific situation in which such a system could be used, it is possible to develop and test data-driven solutions for addressing urban development issues. In the development of TOSCA, a use-case template was defined to identify the most crucial aspects in the definition of such a use-case.

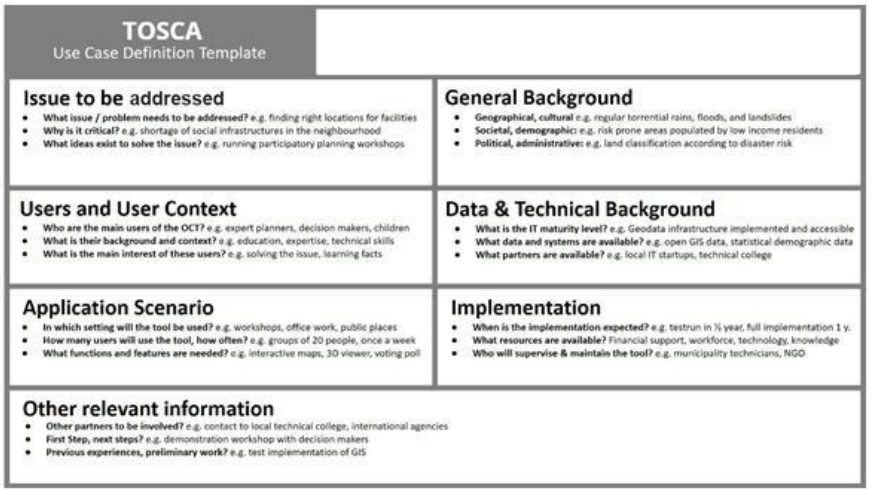

Fig. 3. The use-case template (Digital City Science, HafenCity University Hamburg)

The use-case template helps to identify user-stories that aid in the further advancement of the use case definition, which ultimately translate into tasks and tool functionalities. In order to fill out a use-case template, other knowledge processing tools were implemented, elaborated below.

3.2 The Problem - Tree

A problem tree is an analysis tool that can be used to help stakeholders consider potential solutions that may be implemented to address identified key challenges and provides the opportunity of an overview of all known causes and effects of the identified challenge.

An example of clustering main issues from a general problem statement (Fig. 4) could refer to the beneficiary related issues such as defining accurately the issues citizens, or beneficiaries, face in the approval process for housing development in Palestine. These problems were concluded as- (1) too few broadcasting channels for publication of projects, (2) limitation of news regarding housing projects by only being published in printed newspaper media for two months, (3) unidirectional source of information without an exchange with citizens, and (4) citizens feeling uninformed, unheard and disadvantaged.

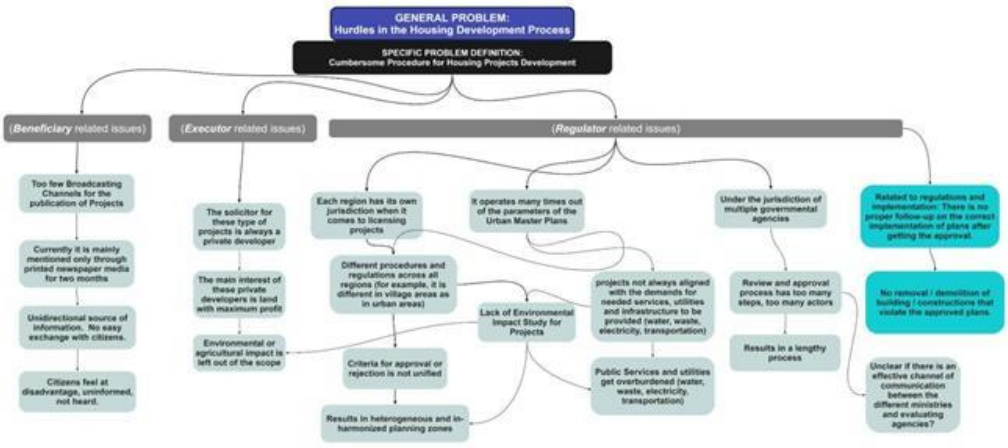

Fig. 4. A Problem Tree Diagram clustering the main issues raised from the case of TOSCA Palestine (Digital City Science, HafenCity University Hamburg)

Understanding these issues in detail made it possible to run a thematic analysis on the identified topics, assess patterns and to reach valuable conclusions.

3.3 Thematic Analysis

A thematic analysis is an approach of qualitative research which allows organising and identification of patterns to interpret the possible relations between the sub-topics of the collected data. After the definition of user-stories, a thematic analysis can lead to certain conclusions that may be valuable for the project, such as the example below, where types of users could be identified for the purpose of an evaluation process and for the purpose of consultation. In the case of TOSCA Palestine, the thematic analysis also helped to identify concrete tasks which could then be translated into technological development tasks.

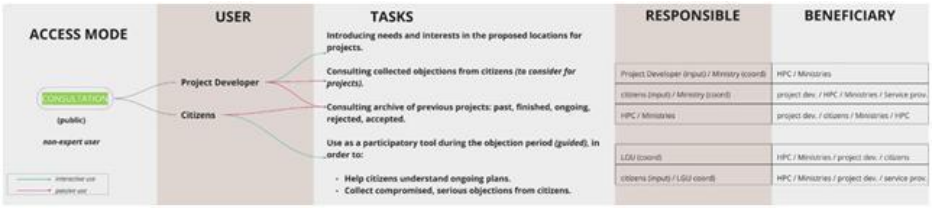

Fig. 5. Streamlining and synthesis of the User Stories into concrete tasks, responsibles and beneficiaries (Digital City Science, HafenCity University Hamburg)

An example of thematic analysis (Fig. 5) could be seen in the conclusion of specific tasks and responsibilities such as the need to build a citizen participation tool during the objection period to help citizens understand ongoing housing development plans and to collect serious and compromised objections from citizens.

3.4 Criticality Effort graph

From the multiple identified user stories, the Criticality Effort graph is used to assess the hierarchy of these user stories according to their level of criticality to be addressed versus effort to be developed. The core idea of this tool is to identify the most pressing needs to be addressed and the effort associated with such needs. The tasks with the highest criticality and least effort of technological development would be selected, while the tasks with least criticality and high

effort of technological development would be considered as low priority to be selected for development within the tool. The Criticality Effort graph was first adapted by the research team to be implemented for the MICADO project where a toolkit was developed for migrant integration in European cities (Zagórski, P. *et al.*, 2021).

Among the different stakeholder brainstorming sessions held during the TOSCA Palestine Use Case, the example below highlights the identification of Task 7 as the task with the highest criticality and least effort of technological development to be fulfilled for the case of Palestine. It was finally selected as the main task to focus on for the definition of the necessary functionalities of TOSCA Palestine. An important criteria considered in the selection of the task was not to re-develop any functionalities covered by the current spatial information system platform, already in use by the local authorities in the region.

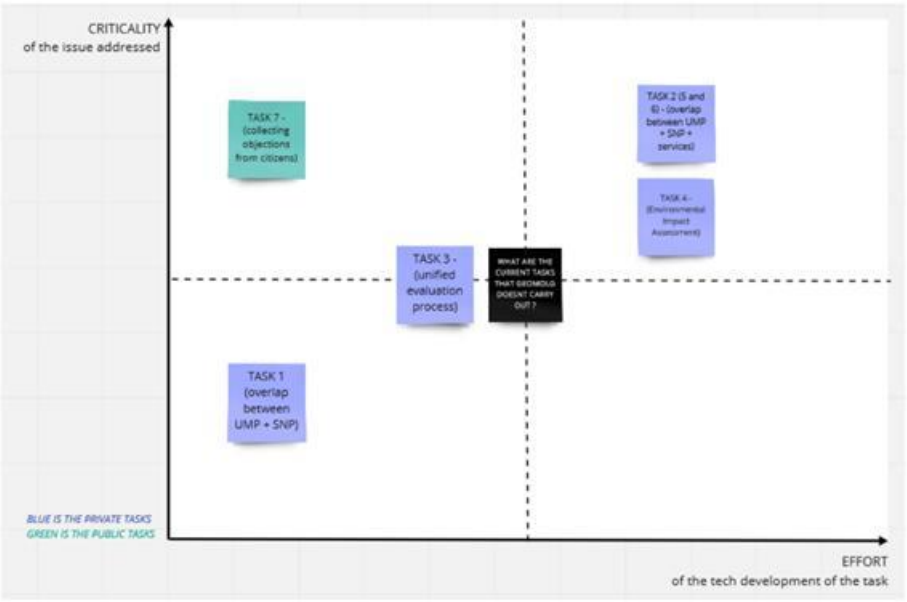

Fig. 6. Collaborative definition on the location of the defined tasks, according to the Criticality-Effort Diagram for the Palestine case (Digital City Science, HafenCity University Hamburg)

3.5 Double-diamond

In order to transition from a larger scope of discussion among all involved stakeholders to the synthesis of the most important topics collected throughout

the process, the double diamond process is used for the development of user experience design (Eissa, C., 2020). This tool aids in the transition from the collective discussion of needs to a more specific and technologically oriented second stage of the project.

Activities such as *asking, listening* and *sorting* are utilised to reflect upon the need of the user which leads to the problem definition. The middle point of the double-diamond process has been reached when a consensus on the problem definition is achieved. This marks a pivotal point where activities will shift towards the creative process of designing the requirements for the chosen solution. It consists of *creating, testing* and *designing* in an interactive mode of development during the second phase of the project.

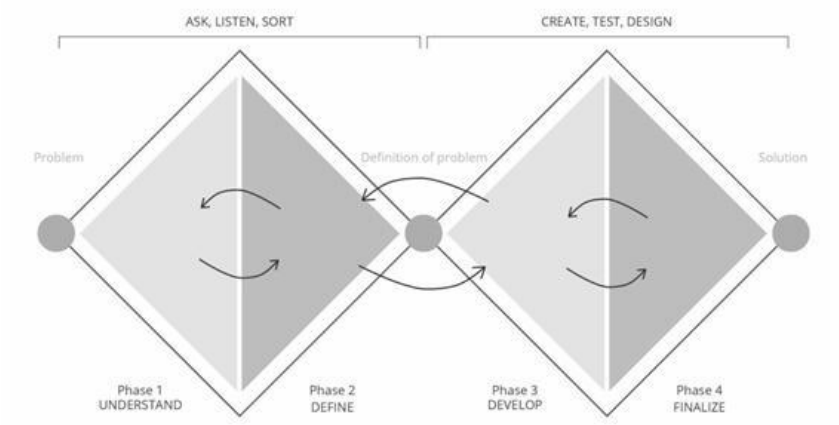

Fig. 7. The Double Diamond Process, implemented for User Experience design methods (Retrieved from Eissa, C., 2020)

3.6 From the Use-Case Epic, to User Stories, to Tasks

The following diagram highlights the process of funnelling the scope of the problem (the use case epic) into a defined use-case and user-stories to concrete tasks and tool functionalities. The ideal scenario is to reach consensus on one main user epic statement, define a specific use-case from the user epic, generate a series of user stories and to break these user stories further into technical tasks and functionalities for the technological development of TOSCA. The synthesis process can be better understood in the diagram below.

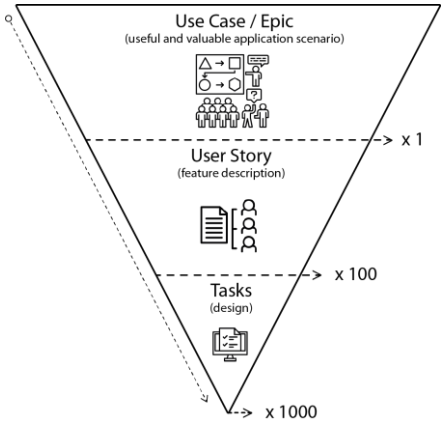

Fig. 8. Diagram depicting the synthesis process from Use Case Epic to user stories and functional tasks (Digital City Science, HafenCity University Hamburg)

An example of this process where content collected through interactive brainstorming sessions carried out at the beginning of a project were clustered and translated into a narrative of multiple user stories is shown in the diagram below. The main Use Case Epic here was 'Streamlining Regulatory Process in land use management for Housing Development in the Palestinian territories' which was broken down by type of user. The example below shows user stories generated for the citizens as end-users.

From the indirect-Beneficiary perspective (Citizens)
• As a citizen, I would like to have a more direct source of consultation to the ongoing housing development projects.
• Citizens would like to have a more interactive, participatory means of submitting their opinions, input and objections to evaluated housing projects.
• The general public (and also the developers and authorities) should have a means of consultation archive of the location of historically approved, pending or rejected projects.
• Citizens believe the social impact of projects in the region is relevant enough to be considered, or even to be reason to object to a project. (How to link social impact to environmental impact in the case of the Palestinian regions?)
• The process of UMP involves citizen participation, but plans for housing projects don't. It could be beneficial for Citizens and also for Public Authorities, that the input collected from participatory processes related to UMP, where visible in the tool (can this input be geo-referenced?...LIG?) so it can be considered for the Housing Development Projects Review?
• Citizens would be interested in the use of this Tool in a workshop session during the period for objection (60 days) to (a) help citizens understand the plans and (b) facilitate citizens' right to make objections.
• Truly concerned citizens would like to not be overlooked, when there is the disruption of non-serious or invalid objections during the objection period. Through the implementation of an assisted, guided, digital participatory process, the truthful and argumented objections can be better identified.

Fig. 9. Clustered list of user stories for the Palestine use-case, according to the citizen as the end-user (Digital City Science, HafenCity University Hamburg)

The use of these tools and methods were instrumental in the collection of tacit knowledge and needs from the user and to translate them into explicit knowledge. The development and adaptation of TOSCA through the use of these methods helped to identify core needs, to engage with different processes and

stakeholders and to adapt the tool for the defined needs of its final user during the implementation of the tool in the three contexts of India, Ecuador and Palestine.

4 Discussion

The implementation of TOSCA across the different cities has helped in identifying four core roles to cover all activities of a successful project. 1) A multilateral corporation as an overarching coordinating and funding agency, 2) a R&D partner capable of adapting and bridging technological knowledge for the specific needs of each location, 3) a local government authority which ensures the provision of data and on-ground connection and 4) a local academic and/or research institution capable of receiving the transferred knowledge and ensuring the sustainable take-up of the tool after the end of the project. The cooperation diagram below depicts the ideal cooperation exchange for knowledge management applicable to TOSCA. This cooperation model emerged after consolidating the learnings from the implementation of TOSCA in the three contexts of India, Ecuador and Palestine.

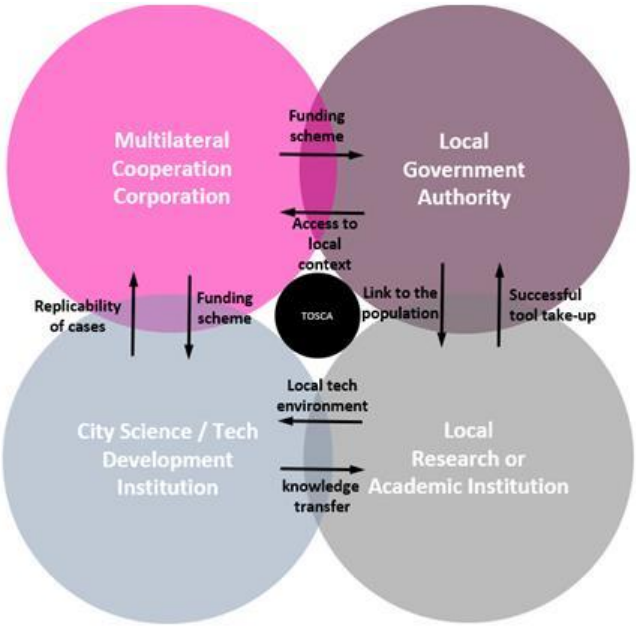

Fig. 10. Emerging knowledge management cooperation model from the on-going learnings on the ideal cooperation scenario resulting from the implementation of TOSCA (authors, 2023)

While the ideal scenario comprises all four roles playing an equal part in the cooperation, empirical work of implementing TOSCA highlighted the varying degrees to which the four roles acquired more or less level of responsibility and active involvement. From this ideal four-helix constellation of actors, the following diagram (Fig. 11) depicts a visual representation of the variation according to the actual involvement of the four identified roles based on the approximate number of people who participated under each of these roles. The radius of each circle was adjusted to the number of people involved in each case. As a result, it can be seen how the Ecuador-case had the largest number of people involved as local partners, distributed across different institutions and technical developers. This was reflected in the wider use of the tool by different end-users after the end of the project. In the case of India, the local institute also played a significant role, however due to the strong technological expertise in this context, the tool was taken up mostly by a concentrated ecosystem. The Palestine case had the most balanced involvement of all its parts, in comparison to the other contexts. However, this model does not account for other qualitative factors such as political willingness, type of local partner, the socio-economic environment or other cultural or social parameters. The adaptation of the knowledge management cooperation model to the different contexts is still in development.

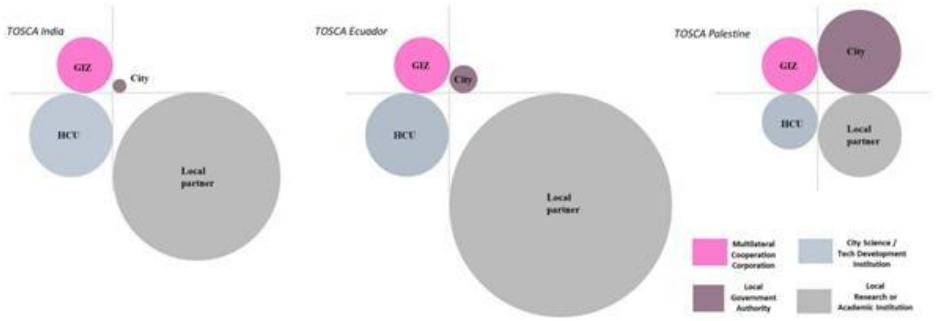

Fig. 11. Adaptation of the knowledge management cooperation model to the three contexts of India, Ecuador and Palestine based on number of participants for each role (authors, 2023)

Some preliminary conclusions which can be drawn from the resulting diagrams can illustrate, for example, that the size of involvement of the city government is similar in the first phase in India and Ecuador that took place from 2019 to 2021. This can be attributed largely to the Corona pandemic that hindered participation

and potentially evidence limited resources or political factors limiting the role of the city for the sustainable application of TOSCA in that phase. There is a need to support capacity building activities for future cases of TOSCA with knowledge transfer to local institutes whose role, locally, can be to ultimately support city governments in the long-term with the acquired knowledge on TOSCA.

5 Conclusions

The implementation of tools like TOSCA highlight the need to consider innovative methods to acquire and process local, emerging knowledge, which can contribute to address more effectively pressing urban challenges, especially in the Global South. An early exploration of the emerging knowledge management cooperation model offers a potential way to systemise methods for gathering knowledge and rendering it applicable to different scenarios. TOSCA as a tool intended to contribute to sustainable urban development, lies at the intersection of these four roles that are codependent on each other in different ways. As an interactive, table-oriented tool, TOSCA has the capacity to bring tacit knowledge at the table and to connect it to the explicit knowledge that is represented through maps and visualisations. The future of TOSCA lies in furthering the 'voicing' of tacit knowledge through table discussions into new explicit knowledge by designing new features though new feedback collection mechanisms, actively augmenting presented data and other methods.

Future TOSCA cases will aim at further refinement of the emerging knowledge management cooperation model and to define and document more tools and methods to streamline the knowledge creation process.

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The Research Architecture for Transdisciplinary Knowledge Synthesis for an Urban Sustainability Programme: A Meta-Study Methodology

Katharina M. Borgmann*

Digital City Science, Hafencity University
Henning-Voscherau-Platz 1
20457 Hamburg

Ágota Barabás

Digital City Science, Hafencity University
Henning-Voscherau-Platz 1
20457 Hamburg

Jörg R. Noennig

Digital City Science, Hafencity University
Henning-Voscherau-Platz 1
20457 Hamburg

* *Corresponding author*

Abstract

In today's globalized world, cross-cultural settings, projects, and institutional setups are becoming increasingly common, presenting both opportunities and challenges. Knowledge creation and management plays a critical role in addressing these challenges by facilitating the sharing of information, ideas, and best practices across different cultures and contexts. However, effective knowledge creation and management in cross-cultural settings requires a nuanced understanding of different cultures, as well as a recognition of the potential barriers to communication and collaboration. One specific area where knowledge generation and management is of particular importance is sustainable development in the built environment. As the world's population continues to grow and urbanization accelerates, sustainable development is increasingly recognized as a critical challenge that requires urgent action. To address this challenge, knowledge creation and management approaches that can facilitate the exchange of ideas, best practices, and innovative solutions are essential. However, effective knowledge creation and management in this context requires an understanding of the unique cultural, social, and economic factors that shape different communities' perspectives on sustainability.

Against this backdrop, this paper presents the set-up of the SURE Facilitation and Synthesis Research Project, focusing on the conceptual architecture for its synthesis research. Part of the BMBF funding initiative SURE along with the ten collaborative projects, this project facilitates the synthesis of knowledge about and the development of solutions for sustainable and resilient urban and rural development in Southeast Asia and China. The project focuses on the transdisciplinary synthesis of research outputs from the SURE collaborative projects, the identification of research gaps, and the development of knowledge generation and management approaches to support the implementation of sustainable solutions, while its primary goal is to contribute to transdisciplinary knowledge synthesis, sustainability research, and urban research. The project focuses on utilizing a multi-method approach that combines empirical research with artificial intelligence tools to analyse qualitative and quantitative data. The project team employs digital tools to structure data and turn it into accessible knowledge that can be used in transdisciplinary urban sustainability projects and beyond. The overarching goal of the project is to contribute to a new research approach that synthesizes knowledge in the topic area of urban sustainability.

Keywords – qualitative meta-analysis; synthesis research; sustainability science; knowledge creation and management, transdisciplinary knowledge synthesis

Paper type – Academic Research Paper

1 Introduction

This paper is a detailed introduction one of the two main pillars, or focus areas, of the large-scope meta-research SURE facilitation and Synthesis research project. Thematically, SURE Facilitation and Synthesis research Project (SURE FSR) explores the challenges of synthesis research in cross-cultural settings and institutional set-ups, with a particular focus on sustainable development in the built environment in South-East Asia and China. The activity of this complex project is divided in two main "wings": facilitation and synthesis research.

While this paper only sketches out what the facilitation tasks of the SURE FSR project ecosystem mean, it dives deeper into the project's view on the role of synthesizing knowledge in facilitating cross-cultural collaboration and information-sharing, as well as the potential barriers to effective knowledge generation and management in these contexts – in other words, into the project's synthesis research architecture.

Alongside that, the paper explains the project's knowledge creation and management approach that can support sustainable development in the built

environment in a globalized setting, taking into account the unique challenges and opportunities presented by cross-cultural collaboration. By addressing these critical issues, the project and this paper aim to contribute to a more nuanced understanding of the role of knowledge generation and management in promoting sustainable development and cross-cultural collaboration.

The approach used in the SURE Facilitation and Synthesis research project is transdisciplinary, problem-driven, and solution-oriented. The project employs a meta-study methodology that synthesizes and consolidates existing conceptual, methodological, and empirical knowledge from literature and the ten collaborative projects within the SURE funding priority.

The project also uses a flexible project architecture and adaptive management methods to address the partly asynchronous runtimes and heterogeneous contexts of the different collaborative projects. The research is guided by a set of guiding questions, which are designed to provide practice-relevant results and insights.

Overall, the approach used in the SURE Facilitation and Synthesis research project is designed to support individual research projects and to systematically leverage the cross-project synergy potentials at the funding priority level. The goal is to create conceptual, theoretical, methodological, and translational innovations that integrate and move beyond discipline-specific approaches to address the issue of sustainable urban development.

The SURE funding priority, which stands for Sustainable and Resilient Urban-Rural Development, is an initiative created by the German Federal Ministry of Research and Education (BMBF) focused on the challenges of sustainable development in the face of urbanization, natural resource depletion, and climate change. The SURE funding priority supports collaborative projects that develop locally implementable solution strategies for the sustainable use of resources and an improved quality of life in urban regions in Southeast Asia and China. The focus is on the development and testing of concepts for a sustainable transformation of fast-growing urban regions, which lead to the strengthening of ecological factors and greater resilience in the face of natural disasters and other consequences of climate change.

Facilitation activities within the SURE Facilitation and Synthesis research project

Apart from the synthesis research – the topic of this paper – SURE's other pillar of activity is facilitation. To briefly outline the project's tasks in that regard, three

main areas of work can be named. The first one is offering support to projects at individual project level. This entails, for example, regular one-on-one meetings, project visits (both in Germany and in Asia), or the establishment of an collaboration and exchange platform called SURExChange. The second one is putting in effort to create or expand impact that the ten projects will have in their target locations, but also beyond the programme, understood geographically, formally, practically and scientifically. The third one is working to identify synergies between the projects, creating awareness of such synergies in the project teams, and helping the sides to capitalise on the synergies. Importantly, the facilitation side of SFSRP's activity and the synthesis research side feed into each other in a dynamic feedback loop.

2 Transdisciplinary research and synthesis research: background and theory

Henrik von Wehrden et al. (2019) define transdisciplinary research as "a collaborative approach that engages researchers from different disciplines, as well as non-academic stakeholders such as practitioners, decision-makers, and civil society representatives, in the co-creation of knowledge, solutions, and policies that address complex real-world problems." They emphasize the importance of integrating different types of knowledge, including academic, lay, and practical knowledge, in order to develop more holistic and effective solutions to societal challenges. They also note that transdisciplinary research requires a process of continuous dialogue and learning between all participants, and that it is often characterized by a focus on real-world impact and the co-production of knowledge with stakeholders.

Complementary to that, Walsh and Downe's 2005 publication "Meta-synthesis method for qualitative research: a literature review" discusses the use of meta-synthesis as a method for synthesizing qualitative research. The authors note that meta-synthesis involves a systematic and rigorous process of analyzing and synthesizing qualitative research findings from multiple studies. They highlight the importance of developing clear research questions, establishing inclusion and exclusion criteria, and using a transparent and reproducible process for data analysis. Walsh and Downe also discuss the challenges of conducting meta-synthesis, including the need for careful consideration of the quality and relevance of the included studies, the potential for bias in the synthesis process,

and the difficulty of combining findings from studies with diverse methodologies and epistemologies. Overall, the authors argue that meta-synthesis can be a valuable approach for synthesizing qualitative research findings and generating new insights, but emphasize the need for methodological rigor and transparency in order to ensure the validity and reliability of the results.

Furthermore, Wyborn et al.'s paper (2018) on "Understanding the impacts of research synthesis" aimed to explore the impacts of research synthesis, particularly in the context of environmental management and sustainability. The paper identified four main types of impacts of research synthesis: instrumental, conceptual, capacity-building, and empowerment. Instrumental impacts refer to the tangible, material changes that result from the application of research synthesis, such as changes in policy or management decisions. Conceptual impacts refer to changes in understanding or perception, such as changes in how researchers view an issue or how stakeholders understand the implications of research. Capacity-building impacts refer to the development of skills or knowledge that can be applied beyond the specific context of the research synthesis. Empowerment impacts refer to changes in power dynamics or relationships, such as increased participation of marginalized groups in decision-making processes. The paper also highlighted some challenges and limitations of research synthesis, such as the potential for oversimplification or the exclusion of important perspectives or sources of knowledge. The authors emphasized the importance of transparency and stakeholder engagement throughout the research synthesis process to mitigate these challenges. Overall, Wyborn concluded that research synthesis can have significant impacts in environmental management and sustainability, but that these impacts are context-dependent and require careful consideration of the specific goals and methods.

Cooper, Hedges, and Valentine discussed (2019) the potentials and limitations of research synthesis. Their findings can be distilled into the following list:

Potentials:

- Research synthesis provides a way to integrate the results of multiple studies and identify patterns and trends that may not be apparent in individual studies.
- It can increase the generalizability of findings by combining data from multiple sources and contexts.
- It can help identify areas where further research is needed or where conflicting findings need to be resolved.

- It can provide a way to summarize and communicate the findings of research to practitioners, policymakers, and the general public.

Limitations:

- Research synthesis is limited by the quality and quantity of the studies included. Poorly designed or executed studies may bias the overall findings.
- Synthesizing results across different contexts or populations can be challenging due to differences in study design, measurement, and other factors.
- Publication bias can occur, where studies with null or negative findings are less likely to be published, leading to an overestimation of effect sizes.
- The process of synthesizing studies involves making decisions about which studies to include or exclude, and these decisions can be subjective and may introduce bias.

In all, we hold that the challenges of knowledge creation and management in cross-cultural settings, projects, and institutional set-ups are being tackled through various approaches. Some ways to achieve that are:

1. Building cross-cultural understanding is an important first step. This can be achieved by creating opportunities for individuals from different cultures to interact and exchange knowledge. Cross-cultural training can also be provided to employees to improve their cultural sensitivity and communication skills.
2. Technology can be a powerful tool for knowledge creation and management in cross-cultural settings. Collaboration tools, such as video conferencing, project management software, and online collaboration platforms, such as SURExChange, can help overcome language and distance barriers. Additionally, machine translation software can be used to facilitate communication between individuals who speak different languages.
3. Encouraging knowledge sharing is critical to effective knowledge generation and management in cross-cultural settings. This can be achieved by creating a culture of knowledge sharing within the organization and providing incentives for individuals to share their

knowledge. Knowledge sharing can also be facilitated through the use of social media platforms and other online tools.

4. Building trust is key to effective knowledge creation and management in cross-cultural settings. Trust can be built by demonstrating a commitment to cultural sensitivity, establishing open lines of communication, and being transparent in decision-making.
5. Partnering with local organizations can help overcome cultural and linguistic barriers. Local organizations can provide valuable insights into the cultural norms and expectations of the local community, and can help facilitate communication and knowledge sharing.
6. Adopting a participatory approach can help overcome cultural barriers and promote collaboration. This requires involving stakeholders from different cultures in the knowledge creation and management process, and actively seeking their input and feedback.
7. Finally, creating a strategy is essential to effective knowledge creation and management in cross-cultural settings. This involves identifying the organization's knowledge needs, developing a plan for meeting those needs, and regularly evaluating the effectiveness of the strategy.

Knowledge creation and management approaches for sustainable development in the built environment in a globalized setting have been developed to address the challenges of promoting sustainability in the face of rapid urbanization and globalization. While these approaches are crucial, they also face several critical challenges and limitations.

One of the significant challenges is the difficulty in effectively sharing knowledge across different organizations, communities, and stakeholders. Sustainable development in the built environment requires the collaboration and cooperation of multiple actors, each with their unique knowledge and perspectives. Knowledge creation and management approaches must be designed to promote collaboration and communication across these actors, but it can be challenging to do so effectively.

Another limitation is the lack of empirical evidence on the effectiveness of knowledge creation and management approaches for sustainable development in the built environment. Many knowledge creation and management strategies are theoretical or conceptual, and there is a lack of empirical research evaluating their effectiveness in real-world settings. Without evidence to support these

approaches, it is challenging to determine their impact on promoting sustainability in the built environment.

Finally, knowledge creation and management approaches must be designed to address the social, economic, and environmental dimensions of sustainability. However, many knowledge creation and management strategies focus primarily on environmental sustainability and fail to address the social and economic aspects of sustainability adequately. Without addressing all three dimensions of sustainability, knowledge creation and management approaches may not be effective in promoting sustainable development in the built environment.

In conclusion, knowledge creation and management approaches are crucial for promoting sustainable development in the built environment in a globalized setting. However, these approaches face several critical challenges and limitations that must be addressed to maximize their effectiveness. To overcome these challenges, knowledge creation and management approaches must be designed to promote collaboration and communication across actors, address different institutional structures and policies, and address all three dimensions of sustainability. Furthermore, empirical research is necessary to evaluate the effectiveness of knowledge creation and management approaches in promoting sustainability in the built environment. Additionally, we need a thorough understanding how (differently) scientific knowledge is created in the different cultural settings and within different contexts, which includes following the questions of how researchers work in different contexts and what are their different rationalities as well as asking ourselves and others: what is supposed to be scientific?

3 SURE facilitation and synthesis research architecture

3.1. Architecture logic

The project looks to synthesize and consolidate existing conceptual, methodological, and empirical knowledge from literature and the ten SURE collaborative projects. This qualitative meta-study aims to contribute to the transdisciplinary sustainable research discourse by providing a scientific contribution to the third epistemic way (Lang, Wiek et al. 2012). The third epistemic way refers to a mode of knowledge production that goes beyond traditional disciplinary and interdisciplinary approaches. This epistemic way is

called "transdisciplinary" and is characterized by the integration of diverse knowledge systems, including scientific, local, and experiential knowledge, as well as the involvement of multiple stakeholders in the research process. The research project is designed to support individual research projects on the one hand and to systematically leverage the cross-project synergy potentials at the funding priority level based on the collected and structured knowledge from the projects and beyond. Conducting meta-research across disciplines and across cultural borders requires a management of knowledge that is sensitive towards these challenges (Ioannidis, Fanelli et al. 2015). Within the SURE facilitation and synthesis research approach, we developed a research and knowledge architecture that allows for constant reflection to improve the applied concepts.

The project goals described above necessitate the several research questions that SURE Facilitation and Synthesis research posits for itself. The six most important ones are:

- Which user group requires/uses what results of the funding priority?
- Which of the results are transferrable or scalable to other regions?
- Is it possible to draw general conclusions?
- How can the gained knowledge be consolidated?
- How are the results fed into the ongoing expert discussions?
- How are the results transferred to experts?

Guided by these, and some more detailed and minor, research questions, the SURE FSR project collects, generates, and structures data before it is turned into knowledge (see Rowley 2007 in contrast to Nonaka 1990). The data is composed of three types of sources: scientific, non-scientific, and directly from the ten projects ("project data"). However, these three sources types can, on another dimension, be split into coming from two "directions": the former two kinds from internal efforts of the project team, while the latter kind thanks to the facilitation activities carried out with the ten projects.

Scientific data can easily be categorized to come from two origins: scientific literature and policy documents (regional, national, international). Non-scientific data includes social media, professional network websites, news outlets, websites, and geo-spatial data. Finally, project data consists of:

- project proposal and report texts
- scholarly publications of the researchers working for the ten projects
- the so-called Synergy Workshops (regular workshops of the ten projects along with the SURE facilitation and synthesis research team)

- project profiles
- peer-to-peer observations
- reference picture questionnaires; network structure
- conference participation output

The data is then organised, structured and stored in a database (Directus).

The collected, generated, and structured data then (1) becomes the object of preliminary data analysis and (2) is used to form research hypotheses. In a double-step approach, the preliminary data analysis then also feeds into the research hypotheses formulation effort, with the goal of solidifying the reasoning and legitimizing the creating hypotheses. Moreover, the research hypotheses are revisited in one of the later steps of the research construction logic. The current set of SURE FSR project's research hypotheses is the following:

- There is a need for thorough knowledge synthesis and consolidation, as well as for methods and practices to do so;
- There is an urgency in recalibrating evaluation schemes and funding criteria;
- There is a necessity for deeper understanding of and sensitivity to cultural intricacies, as well as a guideline on how such skills can be evaluated;
- There is a necessity for a better identification of emerging and existing urgencies and topics;
- There is a need to identify and consolidate cross-cutting issues across the SURE funding priority;
- Project architectures influence the local impact of implementation and how sustainable the projects results will continue to be.

In the next, fundamentally important step of the architecture logic, the data is analysed through the lens of the research hypotheses. This, in turn, activates two further tasks: (1) validation of hypotheses and (2) answering of research questions. Naturally, the exercise of validating the hypotheses is the afore-mentioned revisiting of that item; moreover, the research questions also receive a rededication in this advanced research stage (see Peirce's writings on the three-stage cognitive logic of abduction, deduction and induction, Peirce (1974 [1934]), or Hanson (1958) and Hoffmann (2005)).

3.2. Methodology: a multi-method approach

In awareness that a complex challenge requires a fitting methodology. According to Ashby's Law of Requisite Complexity states that a system must be at least as complex as the problem it is trying to solve. This means that in order to effectively address complex problems, a system must have a certain level of complexity and variety in order to match the complexity and variety of the problem. The law suggests that if a system is not complex enough to handle the demands of the problem, it will be unable to effectively address the problem and will likely fail. Therefore, the Law of Requisite Complexity emphasizes the importance of ensuring that a system is appropriately designed and structured to address the complexity of the problem it is intended to solve (Ashby 2004 [1962]). The SURE Facilitation and Synthesis research project consortium has created a multi-method approach that this section briefly presents. Departing from the vantage point of understanding transdisciplinary knowledge synthesis as integrating knowledge from different disciplines and stakeholders to address complex problems, the SURE FSR team has analysed the state of the art in approaches towards it and has distilled the following five overall, theoretical approaches:

- Participatory research: this approach involves engaging stakeholders, including community members, policymakers, and practitioners, in the research process. That helps to ensure that the research is relevant and useful to those who will ultimately use the findings;
- Systematic reviews: This approach involves identifying, evaluating, and synthesizing existing research to answer a specific research question. Systematic reviews use rigorous methods to minimize bias and ensure that all relevant evidence is included;
- Meta-analysis: This approach involves using statistical methods to combine the results of multiple studies to produce a summary estimate of an effect. Meta-analysis can be used to identify patterns and trends across different studies;
- Mixed-methods research: This approach involves using both qualitative and quantitative research methods to answer a research question. Mixed-methods research can provide a more comprehensive understanding of complex problems by combining the strengths of different research methods;

- Co-creation of knowledge: This approach involves bringing together stakeholders from different disciplines and backgrounds to jointly develop new knowledge. Co-creation of knowledge emphasizes the importance of collaboration and the active involvement of stakeholders in the research process.

Having weighed the strengths and weaknesses of the analysed approaches, the SURE partnership has arrived at the following list of methods applied in daily project work:

- pattern analysis,
- cross-sectional analysis,
- AI-supported data analysis,
    - NLP, MaxQDA,
    - machine learning,
- topic modelling,
- literature review,
- multi-layer analysis,
- knowledge integration,
- knowledge synthesis.

It is necessary to note that one of the items from this list, the AI-supported data analysis within the SURE FSR project framework, is the topic of another paper and presentation during the 2023 IFKAD conference (ID 203), authored by Chintan Patel et al. from the HafenCity University Hamburg with the title *'Unlocking the potential of AI in qualitative data analysis for sustainable urban development'*. It talks about the application of AI to support data and knowledge creation and management in sustainable urban development research by presenting the first results of the ongoing AI-based analysis and discussing how it could contribute to a systemic qualitative analysis of large text-based data sets in urban sustainable knowledge creation and management.

3.3. Outputs

Finally, SURE Facilitation and Synthesis Research Projects's research outputs – another fundamentally important element of a project – can be categorised in two main ones: the so-called Knowledge Synthesizer and the Reference Picture. The former aims to support the generation, integration, and access to sustainability knowledge overall and to include an interactive digital tool for

multiple stakeholders. The latter involves the ten projects' own reference picture and a global reference picture.

Importantly, the current conference will see both of these project outputs items embodied in the form of contributions. The SURE Knowledge Synthesizer is the object of a paper by Agota Barabas et al., titled *'sustainable knowledge synthesizer: a modular tool for urban research'*, from the HafenCity University Hamburg (ID 245) and shows how databases, as well as data services for knowledge creation and management and communication and collaboration, are provided, adapting solutions from business intelligence (e.g. project dashboard, monitors, cockpits), and then aggregated in the functional tool "Synthesizer". The paper discusses the concept of such a synthesizing system and its application in a meta-research environment of transdisciplinary sustainable urban development approaches, sheds light on the opportunities and challenges of the development of such a synthesizing tool, and draws a first picture of the complexity accompanying the development of a "synthesizer". The Reference Picture, in turn, is tackled by the paper authored by Dietrich et al. from the Technische Hochschule Lübeck (ID 209), with the title *'Sustainable development of urban regions. Transformative Research Project as (self-) learning Systems?'* in which, among other angles, the architecture of the SURE Framework and the related Reference Pictures developed by the SURE Facilitation and Synthesis Research project to support the process of observation and reflection are described as a self-learning process of complex systems, and the question how to make the gained knowledge explicit is discussed.

Finally, it is crucial to highlight that both types of outputs in the SURE FSR are systemically tied to the facilitation activity, wherein the Reference Picture is being created directly thanks to the individual project support task, and wherein the Knowledge Synthesizer directly informs all three facilitation tasks.

Figure 1 below *'Overview of SURE Facilitation and Synthesis Research Architecture and linked IFKAD'23 paper presentations'* is a visualisation of the delivered description and the Reader is encouraged to confront the graph with the respective text sections.

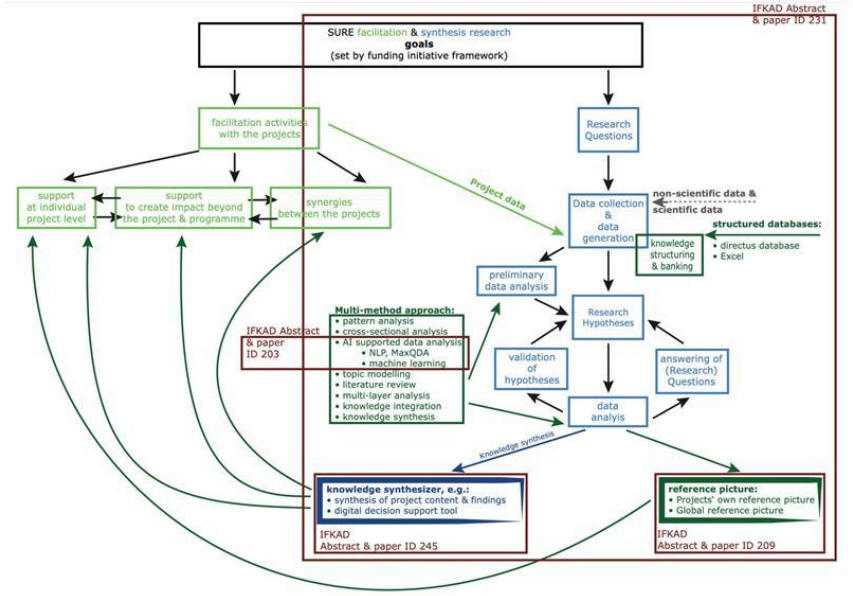

Figure 19: Overview of SURE Facilitation and Synthesis Research Architecture and linked IFKAD'23 paper presentations

4 Summary

The goal of synthesis research is to provide a comprehensive overview of the current state of knowledge on a particular topic, and to identify gaps or limitations in existing research. This information can then be used to guide future research and policy decisions. In the context of the SURE Facilitation and Synthesis research project, the synthesis research involves bringing together the conceptual, methodological, and empirical knowledge from literature and the ten SURE collaborative projects within the SURE funding priority. The aim is to identify patterns, themes, and relationships in the data, and to generate new insights that go beyond what is available in individual studies or disciplines.

The SURE Facilitation and Synthesis research architecture presented in this paper aims to provide a comprehensive overview of the current state of knowledge on sustainable urban development. By identifying gaps or limitations in existing research, information can be used to guide future research and policy decisions. The project aims to create conceptual, theoretical, methodological, and translational innovations that integrate and push beyond discipline-specific approaches to address the issue of sustainable urban development. Overall, the

SURE Facilitation and Synthesis research project aims to contribute to the field of sustainability science and is expected to impact on policy decisions in the future.

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Bridging Integral Human Development and Intersectionality in Business Ethics Research

Rosa Fioravante

University of Urbino Carlo Bo
Via Saffi, Urbino (PU)
Italy

Mara Del Baldo*

University of Urbino Carlo Bo
Via Saffi, 42 – Urbino
Italy

* *Corresponding author*

Abstract

This paper, normative in nature and scope, addresses the social role of working organizations in addressing inequality, one of the Grand Challenges of our time and the 10th Goal among UN SDGs. More in depth, it focuses on a gap in organizational and business ethics literature, so far lacking a perspective on inequality able to bridge Integral Human Development and Intersectionality. While there has been an increase in studies deploying Intersectionality as analytical framework to understand inequality and studies adopting integral human development and the capability approach to suggest strategies and policies to tackle it, no unifying perspective has been conveyed using the two. We argue for their joint deployment with the aim to increase effectiveness of diversity management and policies, as well as to face the challenges connected to the organizational reproduction of inequality. Ultimately, this study provides an original theoretical stance able to propose further path of research as well as suggestions to practitioners aiming to building organizational strategies and cultures based on the values of fairness and gender, racial and social justice.

Keywords – humanistic management, human integral development, intersectionality, gender issue, humanism in business

Nature of proposed paper: Academic research paper, normative

1 Introduction

Grand Challenges of our time are rarely detached one from the other, nor are their consequences on people and societies: climate crisis, economic crisis, geopolitical crisis, all are bound together (Fontrodona & Melé, 2022; Klein, 2007; Waddock, 2020; Wasieleski, 2021). This entangling leads to widespread social inequality and marginalization, thus combining different sources of inequality together (Dil & Zambrana, 2020; Battilana, Ferreras et al., 2022; Philips, Jun et al., 2022; Zhrao & Wry, 2016). Working organizations are increasingly invested by the need to provide robust answer to complex scenarios (Ferraro, Etzion et al., 2015; Waddock & Kuenkel, 2022), whether because of social expectations towards the private for-profit sector (Scherer and Palazzo, 2011) or because of their social mission and hybrid nature (Battilana, Besharov et al., 2017; Vaccaro and Ramus, 2022; Del Baldo, 2019). Lastly, rising inequality keeps raising ethical concerned intertwined with organizational challenges connected to them (Bapuji, Ertug et al., 2020).

Contemporary challenges, even when different in nature, have shown the same underpinning tendency to enhance already existing inequalities, among which gender inequality holds a recurrent central role (Grosser, Moon et al., 2017; Heisig & Kannan, 2020). Disruptive events, such as Covid 19 Pandemic and its social and economic consequences (Alon, Doepke et al., 2020; Carli, 2020; Richter & Patel, 2021; Del Baldo, 2022), as well as fast pace technological innovations, such as Artificial Intelligence widespread implementing (Kelley, Ovchinnikov et al., 2022; Daugherty, Wilson et al., 2019), have shown to be drivers of enhanced preexisting inequality, social exclusion, and marginalization. As inequality imposes significant ethical concern (Beal & Ashtakova, 2017; Heath, Moriarty et al., 2010) as well as economic downfalls on business and societies (Stiglitz, 2016; Stiglitz, 2012) organizational scholars have been recently stressing organizational role in enhancing or halting it (Amis, Brickson et al., 2021; Bapuji, Hertog et al., 2020; Adam Cobb, 2016; Fioravante & Del Baldo, 2021).

Among different streams of research aiming to tackling inequality by addressing its different dimensions altogether, theories of Integral Human Development and Capabilities (Keleher, 2018; Sen 20021) hold a privileged standpoint. Indeed, this approach, both in its confessional stream (Kraemer, 1998; Melé, 2015) and secular one (Nussbaum & Sen, 1993), has been proven valuable

in placing human intrinsic dignity (Melé, 2015) at the heart of business ethics and organizational studies (Schieffer & Lessem, 2016). IHD has led to an ambitious rethinking of the understanding and addressing of different sources of lack of wellbeing, building on the importance of human flourishing in all human life dimensions (such as: physical, moral, psychological), targeting the meeting of all levels of human needs, which inequality undermines (Melé, 2019). This approach has succeeded in stressing the importance of inclusive and fair organizations (Garriga & Melé, 2020), as well as the integral responsibility of working organization to prevent and halt social shortcomings and promote the Common Good (Fontrodona & Sison, 2012).

Alongside the growing interest for the above-mentioned humanistic perspective (Koon, 2021), tackling inequality as intertwining of different sources is increasingly gaining attention from the perspective of intersectionality and intersectionality theories (Kaufmann, 2021; Woodhams, Fernando et al., 2022). Intersectionality as a theoretical approach and a methodology of social enquiry (Raghuram, 2021; Rogers & Kelly, 2021; de Leon & Rosette, 2022) has rapidly been deployed also as framework for organizational guidance and reform (Smith, Watkins et al., 2017; Hearn & Louvrier, 2015). Stemming from debates on feminist ethics (Wicks, 1996; Grosser & Moon, 2019; McKay, 2019) as well as racial segregation and exclusion (Chowdhury, 2021), the intersectionality approach has established a framework for assessing the interplay of different dimensions of oppression at individual, organizational, social and systemic dimension (Collins, 2020).

While a very limited body of literature has so far tried to enquiry into some specific aspects belonging to the IHD and the intersectionality approach (for instance by bridging diversity and the Common Good, Frémeaux, 2020; virtue ethics and feminist ethics, Dillon & Snow, 2018), we highlight a severe lacking of a perspective bridging Humanism and Intersectionality, only marginally discussed in studies focused on other topics (Liu, 2019; Thompson, 2020; Pinn, 2018; Contu, 2020). Which is the theoretical relation between the intersectionality approach and the Integral Human Development in tackling social inequality? How can they be deployed together to discuss organizations' responsibility to do so? Are there specific implications for knowledge management scholars?

The paper contributes to literature on organizational reproduction of inequality (Amis, Mair et al., 2020) and humanistic based social responsibility (Garriga & Melé, 2004; Pirson & Goodpaster, 2016), with specific focus on diversity

knowledge management scholarship (Zifaro, 2010 and 2020). It does so by adding to business ethics literature concerned with inequality a unified framework between Integral Human Development in working organizations (Mongelli, Versari et al.; Del Baldo, 2018) and intersectionality in working organizational (Grosser & McCharthy, 2019). By arguing that IHD and Intersectionality can be adopted as complementary and, therefore, unified theoretical framework for organizational inequality discussion and tackling purpose, we contribute by providing further path of research through defining a model: intersectionality as inequality starting point analysis, addressing the structural causes; IHD as strategic ends setting; organizational practice reform as bridge.

Although inequality is such a wide issue that needs joint efforts by all institutions, by political and social society spheres, and throughout all levels of policy making (Oestreich, 2018; Doyle & Stiglitz, 2014), we contribute to discussing organizational effort towards UN SDG #10[1].

The remainder of the paper is organized as follows: in §1 we present a literature review of the debate concerning organizational inequality and why it needed to be implemented by intersectionality and IHD perspectives; §2 we discuss how to bridge the two within organizational studies and their organizational potential implications; in §3 we discuss consequences and further path of research for Knowledge Management scholars focusing on ethical challenges.

2 Organizations' responsibility towards inequality

Being one of the greatest challenges of our time (Oxfam, 2019), inequality is increasingly discussed by different fields and different perspectives. Social inequality has been at the heart of a long-lasting debate concerning its causes, its justifications, its implications, involving philosophers, sociologists, economists, historians and other fields. This work builds on the perspective of those traditions beholding social inequality as undesirable (Sen, 1997) both for instrumental reasons, such as being economically inefficient for growth purposes (Stiglitz, 2015; Alvaredo, Canchel et al., 2017), and because it increases possibilities of leading to illegal and/or unethical behavior (Rosenblatt, 2012); as well as for intrinsic reasons, being unfair (Sunajko, 2016; Singer, 2018) and stemming from

[1] *https://www.undp.org/sustainable-development-goals/reduced-inequalities?utm_source=EN&utm_medium=GSR&utm_content=US_UNDP_PaidSearch_Brand_English&utm_campaign=CENTRAL&c_src=CENTRAL&c_src2=GSR&gclid=EAIaIQobChMIxLPKrpTo_QIVgdZ3Ch2apAmFEAAYASAAEgIkNPD_BwE*

morally unacceptable socio-economic preeminence of profits over people (Sandel, 2000; Sen 1985; Sen, 1995; Sandelands, 2009).

Nonetheless, the debate on organizational impact of social inequality and organizational responsibility towards it (Bapuji, Ertug et al., 2020), is relatively recent and its implications have not been discussed thoroughly yet. Since management scholars have started focusing on the topic (Beal & Astakhova, 2017), recent comprehensive addressing of what social inequality consists of has been defined as: "To gain clarity on the construct of economic inequality, we contend that it needs to be contrasted with three related constructs: income inequality, wealth inequality, and poverty" (Bapuji, Ertug et al., 2020, p.7). This notion expands previous addressing of social inequality as being focused mainly on one or two of these dimensions (Simpson, 2009; Bapuji & Neville, 2015). Nonetheless, as studies in development ethics stress, social inequality can be understood not only in terms of current monetary disposals and macroeconomics index (such as the Gini coefficient; Hicks, 1997), but in terms of capabilities which are endowed and allowed to each person (Sen, 2001). According to this view, development is consistent not only with economic achievements, but a wider set of variables, among which political freedom, economic opportunity, social opportunities, transparency, security (Sen, 2001). This work aims to integrating the scholarly debate on the dynamics underpinning organizations' influence on social inequality by implementing the adopted perspective with considerations that overcome the understanding of inequality as stemming from income, wealth, and poverty; rather, understanding it in terms of Integral Human Development (Keleher, 2018; Mongelli, Versari et al., 2018). Human Integral Development addresses three level of human needs: basic needs, such as food and shelter; commodities, such as comfort and security and a third level of amenities which comprehend rewarding relationships, fulfilling spiritual life, vocational achievements, among others (Goulet, 2006). According to this view, development is reached only when physical, moral and psychological wellbeing are ensured, when human flourishing is possible (Shrivasta & Zsolnai, 2022; Giovanola, 2019) and all the constitutive humanistic levels are reached at higher capabilities: freedom, transcendence and relationality (Sandonà, 2013; Melé, 2015). This change in perspective on inequality has vast organizational implications, as it is clear that organizations' commitment to lessen inequality and work through goals of integral development entail a larger number of variables to focus on when reforming strategies, policies and practices (Ranis, Stewart et al., 2006).

As anticipated, scholars are beginning to assess organizations' crucial responsibility in addressing social inequality. As society expects higher and enhanced level of commitment towards social welfare as corporations' responsibility (Garriga & Melé, 2004; Baden, 2016). Different streams of social responsibility theories, such as Political CSR, have highlighted how even those social shortcomings once bestowed upon the State and public institutions' responsibility, now fall under private entities reach (Scherer, 2018; Schrerer, Rasche et al., 2016). These considerations can be further detailed and addressed to the specifics of all working organizations, whether traditional for profit, no profit and hybrids (Di Lorenzo & Scarlata, 2019). Social inequality can be considered among the latter. Indeed, the blurring of the lines between public, private and civil society spheres, leads to consider business actors as endowed with the responsibility to act as intermediate bodies (Fioravante & Del Baldo, 2021) and engage in reducing social inequality both for moral reasons of contributing to the Common Good (Sison & Fontrodona, 2012; Schlag & Melé, 2020), as well as to ensure the quality of democracy (Fioravante & Del Baldo, 2023).

Among the many reasons discussed by scholars to promote organizations' responsibility in tackling social inequality (Enderle, 2018), some focus on inequality undesirable consequences in terms of organizational misbehavior and malpractice (Hudson, Gonzales-Gomez, 2021), some on inequality impact on organizational wellbeing (Pfeffer, 2010; Baron & Pfeffer, 1994), as well as on organizational performance (Bapuji, 2015). Different dimensions of organizational practices and policies are addressed, such as the managerial style (Fujimoto & Uddin, 2021), the institutionalization of organizational myths and the performative effect of inequality framing and discourse (Amis, Munir et al., 2018; Suddaby, Bruton et al., 2018) and organizational values (Bourne, Jenkins et al., 2019). This heterogeneous body of literature, which accurately discusses in particular organizational practices which reinforce inequality (Amis, Mair et al., 2020) has already paved the way for further research on how to address inequality through tackling its different sources (Amis, Munir et al., 2018). Nonetheless, extant literature can count on a relatively small number of publications pursuing this goal, both from a normative and empirical perspective (Kaufmann, 2022; Smith, Watkins et al., 2019; Hall & Hall, 1976; Hekman, Aquino et al., 2010). Indeed, while much of the current literature extensively discusses practices to deal with social inequality, a unifying theoretical framework able to

bridge a comprehensive analysis of causes of inequality and suggest organizational actions to tame them, is still lacking.

3 Intersectionality as the starting point

We argue that the literature gaps above discussed, first a lack of research in organizational reproduction of inequality adopting IHD variables, second a lack of research able to fully identify sources of inequality and how they can be tackled together, can be overcome by adopting an intersectionality approach (Atewologun, 2018; Crenshaw, 1991). Indeed, within business ethics literature, neither literature focusing on the organizational reproduction of inequality, nor literature on IHD in organizations has been proposing a unified theory of inequality drawing on intersectionality.

The latter discusses how different sources of structural inequality are intertwined together and how these entangling yields different impacts on individuals, organizations, and societies. Intersectionality is here recalled in its two main aspects, being both a theory of inequality as well as a method of social research (Atewolongun & Mahalingam, 2018). As it has been stressed: "Intersectionality can be conceptualized as an overarching knowledge project whose changing contours grow from and respond to social formations of complex social inequalities" (Collins, 2015). According to this view: "race, class, gender, sexuality, ethnicity, nation, ability, and age operate not as unitary, mutually exclusive entities, but as reciprocally constructing phenomena that in turn shape complex social inequalities" (Collins, 2015). The intersectionality approach is thus useful to discuss sources of inequalities inasmuch it recognizes cornerstone features of their analysis:

- The structural presence of disadvantage (Bowleg, 2013)
- The structural dimension of priviledge (Atewologun & Sealy, 2014)
- The structural experience of disadvantage (Smith, Watkins et al., 2019)
- The structural reinforcement of disadvantage (Hall, Hall et al., 2019).

Intersectionality discusses how the above-mentioned different sources of marginalization impact on people's everyday personal and professional life, combining different effects given by structures of power, systems of oppression and discrimination, impediments to certain positions, roles achievements, self-determination, as well as combining psychological and sociological aspects of personal experience of disadvantage, oppression and injustices. This notion has

been summarized by Davis: "the interaction between gender, race, and other categories of difference in individual lives, social practices, institutional arrangements, and cultural ideologies and the outcomes of these interactions in terms of power" (Davis, 2008, p. 68).

These topics have been dealt with only marginally by scholarship on diversity. Diversity has been conceived as "any mixture of items characterised by differences and similarities" (Thomas, 1996, p. 5). It encompasses several dimensions (primary, secondary and tertiary dimension). The primary dimensions of diversity include age, ethnicity, gender, physical abilities/qualities, race and sexual orientation. Secondary dimensions – that are less visible and sensible than the primary and can be changed - include, but are not limited to: educational background, religion, first language, family, marital and parental status, work experience, military experience, income, communication style and geographic location. Tertiary dimensions comprise features such as: beliefs, assumptions, perceptions, attitudes, feelings, values, and group norms (Rijamampianina & Carmichael 2005; Jirincova, 2013). Diversity can bring a variety of perspectives and insights to an organization, which can lead to increased innovation and creativity. It is also important because it gives organizations access to new markets and talent. In addition, having a diverse workforce can also lead to greater job satisfaction, improved employee morale, and better customer service. When knowledge management and diversity are combined, organizations can benefit from the variety of insights, skills, and experiences that their employees bring. This can lead to increased innovation and creativity, as well as improved performance. In addition, diversity can help organizations identify new markets and gain access to different types of talent. During the last decades both globalization and demographic changes has contributed at increasing diversity of population and labour force. Therefore, the issues of inclusion and diversity are considered key aspects of current society and world politics. In a globalized economy companies recognize the opportunities deriving from a multicultural workforce and try to create more inclusive work environments (Cox, 2001). However, many organizations have been disappointed with the results achieved to meet the diversity challenge (Pless & Maak, 2004). Indeed, most of diversity scholarship addresses organizational behavior and reform concerned with particular marginalized groups (Pless & Maak, 2004), and understands people belonging to these groups as being generally disadvantages in present society, therefore needing specific attention. The same can be said about scholarship

concerned with similar variables and research questions, such as minory entrepreneurship (Vorobeva, 2022). As it is underlined by most literature on diversity and intersectionality, the latter differs from the former in the understanding of a multiplicity of categories of disadvantage instead of identifying groups of disadvantaged (Pompper, 2014; Hearn & Louvrier, 2015). This change in perspective holds vast organizational implications: first, because intersectionality challenges directly how power structures are conceived, while diversity management, policies and practices can be group-specific while overlooking the current hierarchical structure (Hearn & Louvrier 2015; Ely & Thomas, 2020). Secondly, it entails a holistic rethinking of organizational governance, including leadership, to include further subjectivities enacting it (Liu, 2019). Third, it implies a finer grain analysis of inequality as everyday personal life experience, which differs from one case to the other, thus safeguarding the uniqueness of the person and addressing all the causes withholding her development (Steinfield, Stanghvi et al., 2019 ; de Leon & Rosette 2022).

4 From Intersectionality to IHD: organizational role in tackling inequality

In this vein, we propose to use intersectionality as the fundamental approach to discuss inequality in organizations, in order to provide a comprehensive analysis of which are the relevant variables to be tackled in understanding their interplay. As above discussed, within both scholarship and business practice, diversity mostly tackles one diversity group, disregarding the interplay of different factors enabling or disenabling people's achievements. Combining intersectionality and IHD as starting point level analysis (intersectionality) and target setting dimension (IHD), it is possible to envision organizational reform entirely based on a holistic people centered approach aimed to lessen causes and consequences of social inequality in its different drivers and manifestations (Figure1):

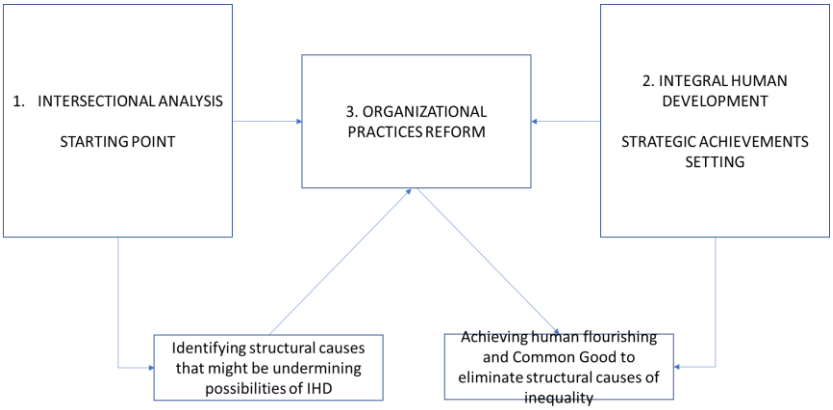

Figure 20 - Process model for combining intersectionality and IHD.

To overcome such limits, in the following figures we discuss how. First, by taking into consideration the three levels of the matrix of domination discussed by Collins (2010), personal level of experiencing oppression due to one or more sources of inequality, group level as in culturally driven dynamics of social reproduction of one or more sources of inequality and institutional level, as in institutional shortcomings determined by inequality. Second, we highlight three variables connected to each dimension which yield higher or lower level of experienced oppression due to inequality and we highlight organizational practices that can directly enhance or halt inequality concerning each variable.

Our analysis is consistent with previous studies on organizational reproduction or halting of inequality (Amis, Brickson et al., 2021), which enlist common practices playing a crucial role in determining increased or decreased inequality outcome: for example, hiring practices, promotion, role allocation (Amis, Mair et al., 2020). We implement them by discussing their relationship with each dimension of the matrix, as well as by adopting for each dimension the interplay in between different sources of inequality (i.e., class, gender, race).

We highlight how each of the three groups of variables have a direct impact in terms of the three constitutive dimensions of IHD: freedom, relationality, and transcendence through three of their main axes: Dignity as foundational of transcendence [Dignity: RESPECTING INTRINSIC VALUE], Fairness as fundamental to relationality [Fairness: SENSE OF BELONGING, PARTICIPATION], Vocation as fundamental to freedom, [Vocation: PURSUE ONE'S TALENT AND HUMAN FLOURISHING].

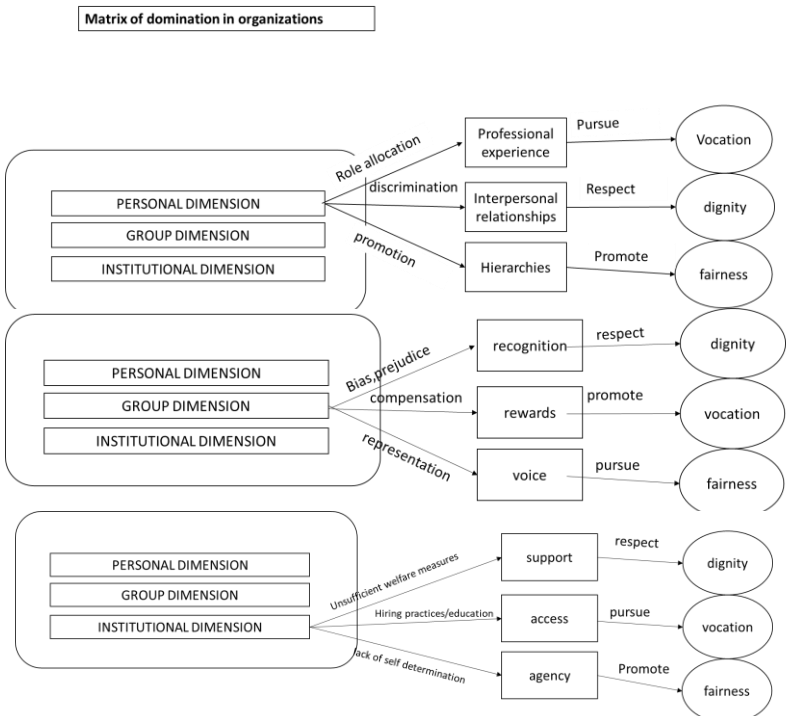

Figure 21 - Matrix of domination in organizations

5 Implications for Knowledge Management Scholarship

Knowledge management and diversity are two key concepts in today's business environment. Both are necessary for organizations to succeed in today's ever-changing world. Knowledge management (KM) is the practice of capturing, organizing, and disseminating knowledge within an organization (Prusak, 2001). KM enables organizations to utilize the skills, experience, and expertise of their workforce to maximize the effectiveness of their operations. It also helps organizations to ensure that new knowledge is incorporated into their operations, thus improving their overall performance.

As such, knowledge management, combined with a renewed perspective on diversity through intersectionality and human integral development, can be powerful tools to help organizations remain competitive and successful in today's rapidly changing business environment. In conclusion, knowledge management and diversity are two key concepts that are essential for organizational success. Combining knowledge management and diversity can lead to increased innovation, creativity, and improved performance. Diversity management fosters

relationships and stimulates discursive processes between diverse cultures. The culture of inclusion and the reciprocal understanding are fundamental to create an organizational culture in which people from different backgrounds respect each other and work to reach common goals. This requires the openness to get involved with people with different perspectives and standpoints. Accordingly, pillars of diversity management are: inclusiveness; integrity; challenging assumptions and mindsets.

Inclusiveness requires openness to different standpoints. Getting people from different cultural backgrounds to share their knowledge, experiences and viewpoints presupposes a basis of trust. Second, a culture of inclusion rests on moral reliability and coherence (integrity). Second, the creation of an inclusive organizational environment implies a cultural change process promoted by cooperative teamworks. Moreover, an inclusive working environment which fosters creativity and innovation potentials of a diverse workforce, rests on a "reflection work" aimed to shed light on existing diversity barriers, remove assumptions that hinder an inclusive approach and identify the steps that are necessary to operationalize management practices. Several authors have investigated the process of learning to effectively implement diversity management, starting from manage (Cox & Beale, 1997) and lead change (Kotter, 1996). The steps of the organizational learning to accommodate an inclusive diversity culture include: raising awareness, creating understanding and encouraging reflection; developing a vision of inclusion; rethinking key management concepts and principles and adapting systems and processes. Accordingly, the funding principles of a human relations management system should include: showing respect and recognition for others and appreciation for different voices; encouraging open and frank communication; cultivating participative decision making and problem solving processes; showing integrity and advanced moral reasoning; adopting a cooperative and consultative leadership style. Our model implements such approach by integrating within it a special attention on structural conditions of marginalization, their interplay and targets to be met to enhance each dimension of Integral Human Development.

Knowledge Management can extensively profit from this approach, for several reasons: first, as intersectionality + IHD model fosters a people-centered approach, it can be applied not only to large firms but also to small medium enterprises; the latter have been relatively less discussed within KM literature (Cantù et al., 2009; Serenko, 2013). Indeed, following Desouza and Awazu (2006,

p.36) it is possible to observe how in SMEs, "knowledge becomes part of the organization's fabric when it is socialized from the manager to the employees, seldom does knowledge move the other way, i.e. from employee to manager" (Massaro et al., 2016, p. 270). Therefore, enhancing higher dimensions of IHD for internal stakeholders can lead to increased bottom-up exchange as well. Second, this model helps to overcome a shortcoming of literature within KM on understanding and discussing variables such as gender, which appears as quasi absent in keywords, and when it does appear mainly as a control variable (Massaro et al., 2016; Cantù et al., 2009; Graham & Nafukho, 2007). Third, since extensive change in organizational culture is needed to implement intersectionality + IHD, this model helps to fill a gap within KM discussing organizational culture in relation with knowledge innovation: results build on Serenko & Dumay (2015, p. 410), who found when analysing citation classics that "Knowledge as a process and managing/competitive advantage dominate earlier rather than later articles", thus underestimating the dimension of organizational culture. Forth, the intersectionality + IHD approach focuses on personal experiences and personal achievements. We recall studies highlighting how knowledge assets or products result from the experience and expertise of individuals. However, the "physical, social, and resource allocation structure" of organizations are important if such experience and expertise is to be translated into competencies that help generate knowledge products (Teece, 2000; McGregor et al., 2004). Therefore, the model helps in addressing possible organizational failings to unleash the personal ability to contribute to knowledge generation, because of structural causes of marginalization and inequality. Lastly, by adopting this standpoint, it is possible to address KM dynamics and social inequality contrast target by the organization at the same time, thus yielding both economic value and social value at the same time.

6 Contributions

This work contributes to scholarship on business ethics and knowledge management in at least three domains:

First, it draws on emerging debate on intersectionality within working organizations, bridging it with a longstanding and relevant tradition of humanism in business as foundational of business ethics scholarship.

Second, it contributes to literature on addressing social inequality through organizations by proposing a model which targets different sources of inequality together, both in understanding their causes and interplay as well as their consequences, thus proposing to overcome some limits of scholarship on diversity and some practical limits of diversity programs.

Third, it proposes a model suitable to address knowledge management in all organizations, including small and medium, which have been so far overlooked; as well as proposing a model focused on people's dignity, fairness, and vocation enhancement, which contribute to build organizational culture and environment suitable for increased innovation and bottom-up knowledge creation and sharing.

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Developing a Knowledge-Based Framework in Financial Firms for Sustainability Change and Reporting

John Holland

The Adam Smith Business School
University of Glasgow
Main Building, Glasgow, G12 8QQ, Scotland, UK

Abstract

This paper aims to enhance understanding and increase visibility and accountability of financial firms through developments in a knowledge-based framework, 'integrated thinking', and reporting for sustainability purposes. This is essential to understand and manage Net Zero and CSR change and associated 'sustainability reporting' and make financial firms accountable in their central role in economy and society.

More specifically, the paper aims to make large international financial firms, and their dynamic change processes, comprehensible, transparent, and accountable.

Three connected knowledge-based problems arise in financial firms– managing change – integrated reporting – and authenticity (Adams 2017; Torre et al 2018, Larsen , 2017, Cho et al 2015). These problems arise when rapid, complex external change such as CSR and Net Zero change pressures, interact with problematic internal predispositions in financial firms. They arise because finance system stakeholders mediate such change and its impact on reporting and 'principles', in their interests (Flower, 2015).

Given these problems the paper argues there is a need to understand how the financial firm is evolving to understand how its sustainability reporting is evolving.

A 'whole firm' or holistic view is required to understand change in financial firm and change in their sustainability oriented integrated reporting (<IR>) by individual firms and standard setting bodies such as IFRS and EFRAG. This takes the form of a 'Behavioural theory of the financial firm' (BTFF), adapted to incorporate CSR, Net Zero, and financial orientations (Holland, 2021, 2022a,b).

This is a knowledge-based framework for guiding financial firm practice and academic research in uncertain times

This sustainability oriented BTFF is used to argue for changes to create a modified <IR> frame for sustainability reporting by individual firms and standard setting bodies such as IFRS and EFRAG. This includes changes in the <IR> 'Octopus' model' of value creation, and development of multi-dimensional view of integrated thinking. The combined BTFF and modified <IR> frames are used to develop a coherent change narrative and metrics as new content in the modified <IR> structure.

The new knowledge in the combined BTFF and <IR> frames and proposed changes in reporting content, are means to change information flows, reporting, and behaviour in the financial firm and in wider systems. They are the basis to enhance management of change and wider stakeholder understanding of change. They are means to develop and exploit new empirical research and theory building on change and reporting.

Keywords – Financial firms, Change, Knowledge, Sustainability, Reporting

1 A 'behavioural theory of the financial firm' (BTFF) and Sustainability Reporting

Section 1 argues that given these problems with change and in developing ideas in the world of practice, an *alternative* research-based approach is required to develop <IR> and sustainability reporting at financial firm and finance sector levels. There is a need to understand how the financial firm is evolving to understand how its sustainability reporting is evolving.

Research approach

A 'finance' oriented BTFF has been developed in embryonic form in a group of publications including Chen et al (2014, 2019), Holland (2010, 2016, 2017b, 2018, 2019a,b). In this paper the BTFF has been adapted to include climate change and CSR issues (Holland, 2021, 2022a,b).

In this paper the BTFF is used to investigate thinking, reporting and <IR> issues associated with such complex and rapid changes. A grounded theory research process (Strauss and Corbin, 1998) is used to show 'What is going on' (Kay and King, 2020), in each BTFF metaphor area and associated 'integrated' thinking, and reporting problem areas The resulting empirical narrative was interpreted through relevant literature to create a theoretical narrative (Golden-Biddle and Locke; 2007; Barnett-Page, 2009). Thus, the BTFF and its grounded theory process (Strauss and Corbin, 1998), was extended by using additional case and archival data. These are used to develop a sustainability oriented BTFF and modify the <IR> frame and its role in sustainability reporting on Net Zero and CSR change (IFRS, 2022a; EFRAG, 2021). This creates a combined conceptual frame to explore how to change <IR> and enhance authenticity. The process of building of a BTFF (Holland, 2016, 2019a, 2021, 2022a,b), and modifying the <IR> frame for sustainability reporting is of significance to this paper because it involves *academic processes* of *integrated thinking***.**

Brief statement of the adapted BTFF

The brief statement of the *adapted* BTFF discussed below provides a "sneak peek into the investigated scene" (Locke, 2001, p. 121). The BTFF is based on insights from an "empirical narrative" interpreted within a "theoretical narrative". This provides readers with a simplified "map" to navigate the paper (Golden-Biddle and Locke, 2007 Barnett-Page, 2009). This draws on a finance oriented BTFF (Holland, 2019a) and green (Holland, 2021) and CSR (Holland, 2022) oriented versions of the BTFF.

The 'Behavioural theory of the financial firm' (BTFF) is based on four case-based themes. These are portrayed as four metaphors (Morgan, 1997) concerning: the 'Head' (top teams), the 'House' (socio-technical system), the 'Community' ('lived and living' experience of employees, customers, and others in system), and decision making in a financial 'Machine'. These non-financial and financial elements form a connected, interacting, changing system.

The first part of the empirical narrative' involves top teams ('Head') 'looking out' in peer groups to learn (Pedler et al., 1997) about external climate change and CSR change pressures and 'looking in' and learning how to change the firm and avoid harm to individuals, teams, and environment. *The second part* involves Top teams making Net Zero and CSR oriented strategic changes to purpose, 'socio-technical' infrastructure in the firm 'House'.

The third part concerns how firm social and knowledge resources are mobilised, how changes are enabled and driven by organisation processes in the 'community'. The latter involve Net Zero and CSR based purposeful communications and interactions at individual, team, firm, and network levels. These multidimensional interactions in internal employees and external stakeholder relations are the locus and focus of change in information production, behaviour, and decisions. This is where much 'value' is created from intangibles and where CSR, Net Zero and financial values are expressed and operationalised. Key internal communications and interactions, occur between top teams, middle management, front, and back-office employees.

The *fourth part* highlights how changes to the non-financial context and working conditions, supports Net Zero and CSR oriented, financial decisions, and products. The latter concern creation of new Net Zero and CSR oriented financial assets and liabilities (and derivatives of) in each firm's specialist domain such as banking, fund management, and insurance. These satisfy CSR and Net Zero aims and avoid harms.

The above *adapted* BTFF is a form of integrated thinking on how to pursue a complex mix of financial and non-financial aims including financial and real economy aims, and CSR and climate change (CC) outcomes. This forms a new conceptual framework for understanding financial firms and developing <IR> ideas in a world of changing sustainability reporting (IFRS, 2022a; EFRAG, 2021).

2 BTFF interpretation of 'Octopus model' of <IR> for financial firms

Section 2 uses the BTFF as a novel theoretical and empirical base to modify the <IR> frame by adapting the <IR> based **'Octopus model'** of value creation (figure 1, p20, VRF, 2022) to reflect the unique finance dominated characteristics and functions of financial firms. Figure 1 shows how the <IR> 'octopus' view of the business model of firms (figure 2, p20, VRF, 2022) including financial firms can be modified to reflect the BTFF and its metaphors. This links BTFF metaphors of 'Head, House, Community, and Machine' to the structure of the <IR> 'Octopus model' and idea of a business model. The BTFF clarifies links between 'non-financial' value creation' and 'financial resources value creation' to achieve Net Zero, CSR, and financial outcomes.

The static and two-dimensional view embodied in the 'Octopus model' does not capture the multidimensional nature of intangibles and financial resource and their dynamic interactions over time. However, the BTFF empirical narrative and interdisciplinary theoretical interpretation and their role in modifying the <IR> octopus model provides a 'window' into these resources and their dynamics in the highly significant finance sector. This provides novel content in *the* <IR> 'octopus model' about financial firms. These can aid the reader to understand more about the complex nature of intangibles and financial resources and the way they interact to change information, behaviour, and financial decisions in the business model. Thus the <IR> narrative concerning the modified 'Octopus model' and its connections between 'intangibles value creation' and 'financial resources value creation' in financial firms can be further developed by exploiting the BTFF empirical insights, and associated literature. The latter includes literature on say business models (IIRC, 2013; Rimmel et al, 2019); and on financial intermediation (Scholtens and Wensveen, 2003; Holland, 2019a, Mio et al, 2022).

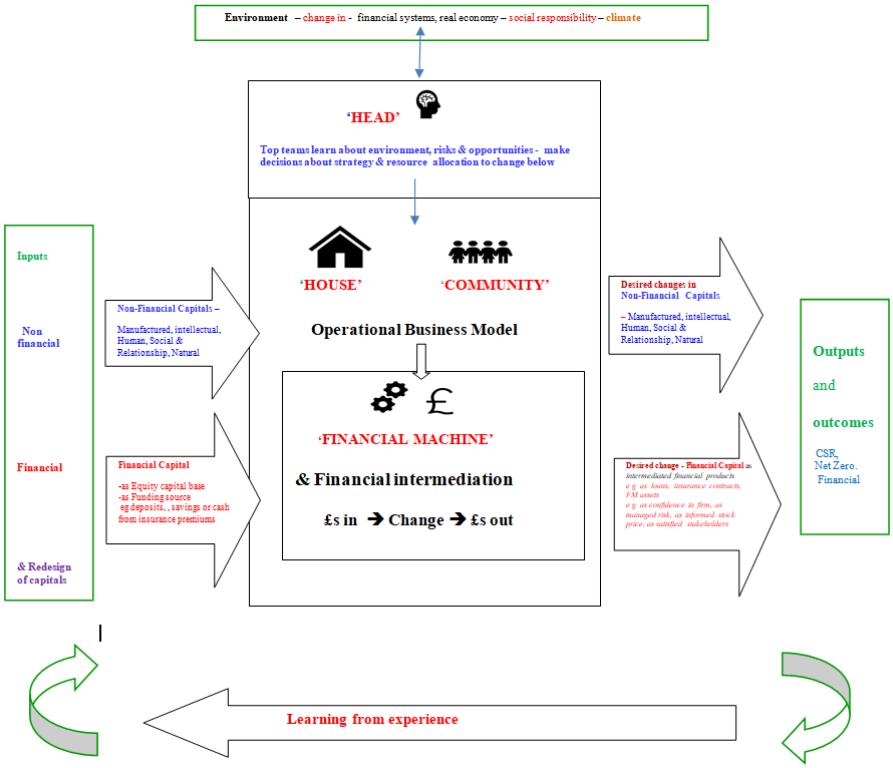

Figure 1 - BTFF interpretation of 'Octopus model' of <IR> for financial firms

From the IIRC (2013)and VRF (2022 perspective, the BTFF version of the 'Octopus model' illustrates how the financial firm's business model is a top team ('Head') driven system for transforming intangible and financial resource inputs to achieve CSR, Net Zero, and financial aims. It does this through social and knowledge structures (in 'House'), and processes and business activities involving team behaviours (in 'Community'), and their impact on financial decision activities (in the financial 'Machine').

The financial 'Machine' as the core of the specialised business model encompasses the formal means for management of risk and return within the firm and external customer networks. These include management of specialist financial portfolios such as loans, deposits, equities, and insurance products. It includes the transformation of financial capital (risk, return, liquidity, maturity etc) through financial intermediation. This shows how many input resources are transformed into outputs.

Thus the 'Head','House' and 'Community', as non- financial resources, have a major impact on the use of financial resources and in supporting their resilience in the financial 'Machine'. Intangibles in these metaphor areas such as knowledge and social structure, *influence* strategic choices about financial risk behaviour, soundness, and orientation. They form additional non-financial buffers against risk. They influence the CSR, Net Zero and financial orientations of such behaviour when using financial resources.

3 Developing 'integrated thinking'

Section 3 uses the BTFF and its connections to the <IR> 'Octopus' model to articulate academic and practice ideas of 'Integrated thinking'. The BTFF is an academic form of 'Integrated thinking'. In grounded theory academic research (Strauss and Corbin, 1998), integrated thinking occurs when academics identify connected empirical themes. They build a theory such as BTFF that reflects insight and themes from cases (problems, working solutions) and literature interpretation. The BTFF, once developed, is a form of integrated thinking which can contribute to such processes in practice.

The BTFF provides a research and case-based idea and example of 'integrated thinking' by connecting metaphors of 'Head, House, Community, and Machine' in a holistic conceptual framework. This aids the identification of clear aims, core factors, connections, and interactions in financial firms, backed by evidence. In the BTFF terms, 'Integrated thinking' concerns how resources (strategic, intangible, and financial) are co-ordinated, connected, and mobilised.

The BTFF's approach to integrated thinking also provided a means to develop more complete and integrated explanation of the business model (IIRC, 2013) in specialist financial firms pursuing Net Zero, CSR, and financial aims. Hence the BTFF is consistent with the aims of the Integrated Reporting framework (IIRC, 2013; VRF, 2022) to place the business model and its explanation of the entire value creation process in firms at the heart of corporate reports. This aids development of Integrated Reporting or <IR> and its principles in financial firms consistent with changes in sustainability reporting (IFRS, 2022a; EFRAG, 2022) .

The case firms indicated that, 'Integrated thinking' reflects the ability of top teams and other employees and external stakeholders to understand *change, intangibles, and tangibles, and their development, and interactions, to change thinking capabilities, behaviour, and produce desired outcomes in the whole firm*

and external networks. The BTFF indicates that these interactions and connections must be directed in a comprehensible, open, and explicit way in the firm.

4 Developing Integrated Reporting content about financial firms

In **section 4** the BTFF and modified <IR> frame and principles ('Octopus' model and Integrated thinking) are used to analyse 'missing information' and gaps between internal and external accounts by the firm in communications and integrated reporting (Rimmel et al, 2019).

4.1 Gaps between internal and external accounts and 'missing' information in <IR>

Chen et al (2014, 2019) and Rimmel et al, (2019) note how differences or gaps arise between internal and external accounts of how financial firm transform inputs and produce outputs and outcomes (Chen et al 2014, 2019). Problems of 'missing' information arise for stakeholders in these accounts when communicated internally and reported externally.

Gaps and variation in internal and external accounts by financial firms persist despite improvements in reporting. For example, significant gaps have been observed between the inside information positions of bank management ('Head'), and observers in external MFI communities such as bank analysts and fund managers, especially in problem cases such as RBS and Well Fargo. Questions have raised about the authenticity of publicly stated sustainability policies and sustainability reporting in fund managers and banks such as Blackrock (Fancy, 2021) and HSBC (Kirk,2022; Liang, (2022), as a result of actions by employees to 'lift the veil' on internal accounts.

The UK FCA (2021, 2022) has identified problems with asset managers ESG oriented products; marketing and use of labels such as ESG', 'green' or 'sustainable'; and disclosures on ESG funds and demanded improvements to build high standards and clamp down on greenwashing.

4.2 Using BTFF and modified <IR> - to find 'missing' information in <IR>

The BTFF is used to summarise broad categories of narrative disclosure content possible in <IR>. These **broad** categories and factors in each metaphor

area, have all been identified from the BTFF (Holland, 2016, 2019a, 2021, 2022a,b). For example, 'missing' information could be identified by additional narrative reports on specific intangibles such as human capital of top teams ('Head') and employees ('Community') and financial investment required to develop these. This could involve discussion of expected benefits of creating other intangibles (in the 'Head' or 'House'), and their role in increasing value, or avoiding risk in the financial 'Machine'. For example, NatWest reported how it had recruited climate change expert Nicholas Stern to help shape its sustainability strategy Stern was recruited to challenge and advise them as they worked in a collaborative way to move forward (NatWest, 2020).

'Missing information' could include explanatory narrative how these decisions and intangibles were connected in processes that encouraged employee cooperation required for innovation and creativity. In case financial firms, innovation concerns, inter alia, adoption of CSR and Net Zero policies in top team and employee behaviour, and in behaviour with customers. Innovation concerns the design and delivery of CSR and Net Zero oriented financial products desired by customers, leading to financial value for shareholders. Information relevant to this could include narrative based insights into staff development, retention, and succession and how this is connected to other key intangibles such as customer relations and new product design. Information on these activities reflects integrated thinking in the firm. Disclosure is likely to enhance <IR> by overcoming problems of connectivity, definitions, and use of terms such as ESG (Liang, 2022) and 'capitals' (Larsen, 2017). Zanin al (2021) demonstrated that innovative firms with connected narrative of firm dynamics are more likely to disclose <IR> policies than non-innovative firms, and innovative firms that demonstrate high outputs of innovation activities are likely to disclose <IR> policies.

External guidance and frames of reference can also be used to identify 'missing information'. Triodos's use of UN SDGs to structure web-based narrative communications to the public (Vaccoro, 2019), demonstrates their integrated thinking on these matters. It indicates how financial firms can use SDGs to further develop <IR> as suggested by Rizzato et al (2021). In this paper, the BTFF and modified 'Octopus' model of <IR> provides an external academic frame for financial firms to think how to develop <IR>.

5 Discussion and analysis

The above sections illustrate how the BTFF and modified <IR> frames are a combined basis in the world of practice, both at the level of individual firms and in system wide reporting standard setting processes, to enhance integrated thinking, and <IR> structure and content. The adapted 'Octopus' model in Figure 1 connects the four metaphors of 'Head', 'House', 'Community', and 'Machine' in the BTFF to the core components of the business model in <IR>.

This provides new insights into the social, knowledge and technology context for the business model in financial firms. It provides means to overcome problems of reporting in <IR> on intellectual capital or knowledge-based intangibles (Songini et al, 2021). These insights can be used to support and enhance <IR> narrative and metrics on CSR and Net Zero Change in financial firms.

This provides means to closely connect internal and external accounts of business models and identify 'missing information' in <IR>. They provide means for internal and external observers to assess how wide the gap between internal and external accounts of business models may be, and how they can be closed.

This can be used for internal purposes to improve communications and performance, and for external corporate reporting purposes (such as <IR>) to enhance understanding of the financial firm.

The combined BTFF and <IR> frames provide a common - conceptual basis, narrative, and metrics – to improve transparency across all financial firms in 'Sustainability Reporting' standard setting (IFRS, 2021; EFRAG, 2021; GRI, 2022). The frames are a basis for ISSB, EFRAG, and GRI to exploit <IR> principles and core ideas, when developing sustainability reporting standards (structure and content), to match the complex nature, purpose, function, and dynamics of financial firms identified in the paper. This theory-based approach can complement attempts by practitioners as they continue to use <IR> ideas (IFRS, 2022a; EFRAG, 2021) and apply a principles-based approach to 'sustainability reporting' to individual sectors, and all sectors.

The paper reveals the central role of existing theory in business and management, sociology, and finance to explore insights into empirical findings in integrated thinking and integrated reporting. This indicate that existing paradigms, when used in new ways can help progress thinking about sustainability reporting both in academe and practice.

The paper also argues that enhanced <IR> disclosure and use of new BTFF metaphor-based categories, data, and metrics is a new basis for hypothesis generation and tests of hypotheses. The metaphor-based narratives and metrics form a new basis to develop tests for 'IRwash', 'CSRwash' and 'Greenwash'.

It could be hypothesised that the degree of achievement of CSR, Green and financial aims is a function of connected and combined changes in key variables in all of the empirical themes or metaphors. The positive or negative role of quantifiable factors in each metaphor area – on CSR, green and financial 'success', (and in history, dominant context) is a way to test for '<IR>wash', 'CSRwash' (Pope et al, 2016) and 'Greenwash' (Mattis, 2008) in very different banking firms such as Triodos and NatWest.

This is a means to test for the authentic behaviour, or for false and dysfunctional behaviour - in each metaphor area of top teams (Head), organisational life (House, and Community), and financial decisions (Machine) – and in the firm overall.

6 Summary

The paper has noted problems in understanding and managing financial firms such as banks, insurance firms and fund managers (Chen et al 2014,2019, Holland, 2010, 2018, 2019a,b) during complex and rapid change. These have contributed to problems of integrated thinking and development of integrated reporting (<IR>) in financial firms (IIRC, 2013, Larsen, 2017; De Villiers & Dimes,2022). Questions have arisen about the role of top teams, institutional shareholders, and accounting professionals, in mediating wider understanding and reporting of complex changes such as climate change and CSR change pressures, in their shared interests (Flower, 2015; Holland, 2017a, 2019b). This interpreted as 'organised hypocrisy' and use of facades in action and reporting (Cho et al, 2015; Brunsson,1993) at meso level by elites in 'community of practice' (Lave and Wenger 1991).

The above contribute to problems of 'missing information' in integrated sustainability reporting. These problems are a basis for scepticism that organisations such as financial firms will deliver authentic CSR change and reporting (Schoeneborn et al, 2020; Cho et al, 2015; Brunsson,1993).

Given these problems the paper argued that developing <IR> and sustainability reporting needs an *alternative* research and theory-based approach

at financial firm and finance sector levels. There is a need to understand how the financial firm is evolving to understand how its sustainability reporting is evolving.

Thus, the paper argued that a 'whole firm' view was required to understand change in financial firm and to use this to modify use of <IR> principles in sustainability reporting (IFRS, 2022a; EFRAG, 2021). This whole firm view was expressed as a 'Behavioural theory of the financial firm' or BTFF, with CSR, Net Zero, financial orientations (Holland, 2021, 2022). The 'soft' components of the BTFF (as 'Head, House, and Community' metaphors) are where authenticity is developed for 'hard' financial activities and their sustainability outcomes in the financial 'Machine' metaphor as the core of the business model.

This *sustainability oriented* BTFF is used to argue for changes to create a *modified* <IR> frame for sustainability reporting by individual firms and standard setting bodies such as IFRS and EFRAG. This includes changes in the <IR> 'Octopus' model' of value creation, and development of multi-dimensional view of integrated thinking. The combined BTFF and modified <IR> frames are used to develop new content in the *modified* <IR> structure.

Knowledge' in these forms, is the basis for employees and stakeholders to understand what 'non-financial information' and 'Relevant or material information' (EU, 2014; Baumuller, 2018) is in financial firms. This shows the importance of a field research and theory approach to developing corporate reporting.

The joint use of the BTFF and <IR> frames create a dynamic investigative tool to develop theory, research, integrated thinking, <IR>, and authenticity. For example, the combined frames are the basis to develop new academic research on <IR>, including empirical tests and conceptual development of the links between <IR> and the nature of the firm. These can form the basis for tests of '<IR>wash', 'Greenwash' and 'CSRwash'.

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The Impact of ESG Perception on Universities

Fabio Nappo

Dep.t Economics and Law
University of Cassino and Southern Lazio
Via S. Angelo, Loc. Folcara, 03043 Cassino, Italy

Federico Schimperna*

Dep.t Economics and Law
University of Cassino and Southern Lazio
Via S. Angelo, Loc. Folcara, 03043 Cassino, Italy

Maria Schimperna

Independent scholar

Sara Gigli

Independent scholar

* *Corresponding author*

Abstract

During the last two decades, sustainability issues, such as climate change, depletion of natural resources, or bad working conditions, gained considerable attention in the literature. Investors, consumers, suppliers, employees, public powers, and non-governmental organisations are increasingly requiring the development and implementation of sustainable practices, considering that sustainability and environmental, social and governance (ESG) factors became drivers able to affect companies' performance and are considered a source of competitive advantage.

In the current scenario, universities play a pivotal role in the transition to a sustainable society, providing students with knowledge about sustainability, ethical values, and human rights, contributing also to the achievement of the 17 Sustainable Development Goals (SDGs) of the 2030 UN Agenda. The perception of the relevance of sustainability and ESG issues fosters the universities to make investments for organizational restructuring, adjusting planning and controls, transforming their own missions, broadening their curricula, and providing non-financial disclosure. Particularly, non-financial disclosure is a strategic tool at least for the following three main reasons: to i) affect the way they are perceived and regarded externally; ii) legitimize their business activities to stakeholders; and iii) appear as good corporate citizens.

In the light of the previous considerations, this research paper tried to understand if the ESG factors can affect the performance of universities. Our analysis considered only the Italian mega-universities and was based on the ESG Perception Index for the period June-October 2021 as a tool for assessing the value of the relevance given to ESG issues by universities. This indicator was retrieved from the Reputation Science's Report. We carried out a multi-stakeholder analysis to understand if there is a correlation between the ESG Perception Index and economic variables related to the following three categories: i) students; ii) professors; iii) the Ministry of Higher Education. The findings showed a significant positive correlation between the ESG Perception Index and the considered variables. In order to validate these results, we developed a content analysis of universities' sustainability reports, based on the presence of keywords related to environmental, social, governance/transparency, and sustainability issues and then we used the retrieved level of non-financial disclosure as a control variable. Thus, these findings provide insight into how ESG perception can affect universities' performance and can be useful for academic researchers, policy-makers, and practitioners.

Keywords – University, ESG, sustainability, disclosure, non-financial report

Paper type – Academic Research Paper

1 Introduction

During the last two decades, more and more stakeholders are posing non-financial elements as the main theme in their investment choices, especially from an ethical point of view (Amstrong et al., 2020; Huang et al., 2022). Sustainability issues, such as climate change, depletion of natural resources, or bad working conditions, gained considerable attention (Simoni et al., 2020) and environmental, social and governance (ESG) factors became drivers able to affect companies' performance and are considered a source of competitive advantage (Eccles and Serafeim, 2013). In this scenario, the adoption by all United Nations (UN) members of the 2030 Agenda for Sustainable Development Goals (SDGs) represents an important step towards a more sustainable future (ONU, 2015; Huang et al., 2022).

In this process of transformation, universities play a crucial role, because they are called to form the future ruling classes. Universities have rethought their curricula to train managers and leaders who can help make the society to be more sustainable (Schimperna et al., 2022). The social role of universities is not limited to the promotion of principles and values through research and teaching (Sitnikov et al. 2018; Ali et al. 2021), but it also concerns the development of

management and community outreach (Hernández and Saldarriaga, 2009; Schimperna et al., 2022). All the new trends and needs led to a greater perception of the relevance of sustainability and ESG issues, pushing universities to make investments for organizational restructuring, adjusting planning and controls, transforming their own missions, broadening their curricula, and providing non-financial disclosure (del Mar Alonso-Almeida et al., 2015; Hernández García de Velazco et al., 2020).

In the light of the previous considerations, this paper tried to understand if the ESG factors can affect the performance of universities. The analysis considered only the Italian mega-universities and relied on the ESG Perception Index for the period June-October 2021 as a tool for assessing the value of the relevance given to ESG issues by universities. This indicator was retrieved from the Reputation Science's Report. We carried out a multi-stakeholder analysis to understand if there is a correlation between the ESG Perception Index and economic variables related to the following three categories: i) students; ii) professors; iii) the Ministry of Higher Education. Lastly, we validated our results through a content analysis of universities' sustainability reports.

The rest of the paper has the following structure: paragraph 2 shows the literature review; paragraph 3 explains the research methodology; paragraph 4 provides results; and paragraph 5 highlights the conclusions.

2 Literature review

Climate change, pollution, depletion of natural resources, and bad working conditions are problems of our times no longer negligible and need a solution (Russo et al., 2021; Lombardi et al., 2022). The current condition of the planet requires today's generation not to make the same mistakes as in the past: it is necessary to reverse course. All this can only be done through sustainable development (Griggs et al., 2013). The World Commission on Environment and Development (1987) defined sustainable development "*the development that meets the needs of the present without compromising the ability of future generation to meet their own needs*". Sustainable development is also demanded by stakeholders, like investors, employees, consumers, public power, non-governmental organisations, and suppliers (Kolk and van Tulder 2010; Duque-Grisales and Aguilera-Caracuel 2019; Russo et al., 2021; Schimperna et al., 2022)

and the application of corporate social responsibility (CSR) principles can positively affect firm's market value (Lu et al., 2021).

In 2006, when the United Nations launched the Principles for Responsible Investment (PRI), the acronym "ESG" was introduced for the first time (Huang et al., 2022) and now ESG factors are also considered three central elements in measuring sustainability of an investment. On the basis of the most commonly used frameworks, local pollution, GHG emissions, biodiversity, water usage, energy consumption, waste management and production can be valuable examples of environmental factors; social factors can refer to inequality, discrimination, human rights, labour and workforce, and gender rights; while governance factors include issues related to the board and management, such as anti-corruption, codes of conduct, and board diversity (Loizzo and Schimperna, 2022).

Many features can affect ESG performance, among which the size of a company through the availability of more resources (Drempetic *et al.*, 2020). The proper implementation of ESG practices with positive ESG performances is considered a source of competitive advantage (Eccles and Serafeim, 2013), leading to many benefits, among which: i) to be perceived as positively contributing to environmental and social issues, ii) improve one's standing with the stakeholders; iii) avoid accusations of greenwashing; iv) improve the non-financial (e.g. increase in process and energy efficiency, and reduction in usage of materials) and financial performance; v) increase in firm value (Aras and Crowther, 2008; Friede et al., 2015; Fatemi et al., 2018; Chouaibi et al., 2021; Ahmad et al., 2021; Sheehan et al., 2023).

The 2030 UN Agenda, among the 17 SDGs, calls on Member States to *"ensure inclusive and equitable quality education and promote lifelong learning opportunities for all"* (English *et al.*, 2019). During these years, universities have developed education about CSR and sustainability, introducing new types of curricula, considering that the achievement of sustainable development is related also to the innovation that relies on the availability, creation, management, and sharing of knowledge (Schimperna et al., 2022). All universities are called upon to pursue the following fundamental missions: "*provide students with new competences to create a more sustainable society (Adams et al. 2011) and reduce the environmental impact of their operations (Disterheft et al., 2012)*" (del Mar Alonso-Almeida et al., 2015). However, the social role of universities is not limited to knowledge production and dissemination, typical features of research and

teaching (Sitnikov et al. 2018; Ali et al. 2021), but it also concerns the promotion of principles and values through the development of management and community outreach. The latter two elements, together with research and teaching, are the key attributes of the university social responsibility (USR) (Hernández and Saldarriaga, 2009; Schimperna et al., 2022).

In this scenario, the perception of the relevance of sustainability and ESG issues fosters the universities to make investments for organizational restructuring, adjusting planning and controls, transforming their own missions, broadening their curricula, and providing non-financial disclosure (del Mar Alonso-Almeida et al., 2015; Hernández García de Velazco et al., 2020). Particularly, non-financial disclosure represents an opportunity to communicate the commitment to sustainability (Aureli et al., 2020) and it is a strategic tool at least for the following three main reasons to: i) affect the way they are perceived and regarded externally (Deegan, 2002); ii) legitimize their business activities to stakeholders (Joshi and Gao, 2009); and iii) appear as good corporate citizens (Guthrie and Parker, 1989). In this scenario, the implementation of ESG factors in universities fosters the improvement of the organization's quality and the achievement of the SDGs (Huang et al., 2022).

In the light of the previous considerations, we selected the following research question:

RQ: Can ESG factors affect the performance of universities?

3 Methodology

This research paper tried to understand if ESG factors can affect the performance of universities, considering the role of their perception in influencing stakeholder decisions. Our analysis considered only the Italian mega-universities (excluding the University of Palermo and the Federico II University because of lack of data) and was based on the ESG Perception Index for the period June-October 2021 as a tool for assessing the value of the relevance given to ESG issues by universities. This indicator was retrieved from the Reputation Science's Report and it was built analysing the proximity of the largest companies in the Italian market (according to Piazza Affari capitalisation, Mediobanca ranking, and Interbrand ranking) to the 17 UN SDGs. Particularly, a ranking of 200 companies was provided, and for each of them an indicator was developed (from 0 to 100), based on qualitative-quantitative and structural parameters: in addition to the volume of

content reporting the association between the brand and sustainability, the reputational impact of this content on the brand, the association of the brand identity with sustainability on search engines and the extent to which the company explains sustainability through its proprietary channels (e.g. website, social media) also weigh on the score. 60% weight was given to web intelligence and ESG reputation index (analysing 4 million web contents), and 40% weight to ESG corporate communication, encyclopaedic presence, and digital identity. The result is an expression of the perception generated in the last six months as well as the historical one, because on the web content persists and the past influences the current perception (https://www.esgreputation.it/metodologia).

To answer our research question, we applied a quantitative research method (Black, 1999; Waters and Waters, 2008), carrying out a multi-stakeholder analysis to understand if there is a correlation between the ESG Perception Index and economic variables related to the following three categories: i) students; ii) professors; iii) Ministry of Higher Education (tab. 1).

Tab.1: Selected variables and related category

Variables	**Category**
Number of enrolled students	Students
Total Ordinary Financing Fund for Universities basic quota	Ministry of Higher Education
Revenues for teaching	Professors
Revenues from commissioned research and technology transfer	Professors
Research and teaching staff costs	Professors

Source: our elaboration

Lastly, in order to validate these results, we developed a content analysis of universities' 2020-2021 sustainability reports, based on the presence of keywords related to environmental, social, governance/transparency, and sustainability issues and then we used the retrieved level of non-financial disclosure as a control variable, making a correlation with the ESG index. The following table (tab.2) shows the selected words for the content analysis.

Tab.2: Selected words for the content analysis

Keyword	Group of keywords
Environment	Environment
Environmental	Environment
Environments	Environment
Social	Social
Sociality	Social
Socialisation	Social
Governance	Governance/Transparency
Transparency	Governance/Transparency
Sustainability	Sustainability
Sustainable	Sustainability

Source: our elaboration

4 Findings and discussion

The first step of our research was the analysis of the correlation between the ESG Perception Index and the selected variables. Initially, we correlated the ESG Perception Index with the number of enrolled students. The results highlight a significant positive correlation, showing a Pearson's correlation index of 0,93 (tab.3).

Tab.3: Correlation between ESG Perception Index and number of enrolled students

University	ESG Perception Index	Number of enrolled students
University of Rome La Sapienza	47,135	18.390
University of Bologna	41,995	14.382
University of Turin	41,335	14.505
University of Milan	38,705	11.967
University of Florence	35,79	10.116
University of Padua	34,88	12.342
University of Pisa	32,41	7.343
University of Bari	26,07	7.694
	Correlation	0,931142994

Source: our elaboration

Later, we made an analysis of the correlation between the ESG Perception Index and the Total Ordinary Financing Fund for Universities basic quota. The results

show a significant positive correlation, indeed, Pearson's correlation index is 0,89 (tab.4).

Tab.4: Correlation between ESG Perception Index and Total Ordinary Financing Fund for Universities basic quota

University	**ESG Perception Index**	**Total Ordinary Financing Fund for Universities basic quota**
University of Rome La Sapienza	47,135	291.987.567,00
University of Bologna	41,995	225.321.933,00
University of Turin	41,335	173.236.231,00
University of Milan	38,705	161.926.360,00
University of Florence	35,79	137.314.102,00
University of Padua	34,88	173.615.578,00
University of Pisa	32,41	115.412.030,00
University of Bari	26,07	111.965.663,00
	Correlation	0,885331221

Source: our elaboration

The following analysis concerned the correlation between the ESG Perception Index and revenues for teaching. We found a significant positive correlation with a Pearson's correlation index of 0,84 (tab.5).

Tab.5: Correlation between ESG Perception Index and revenues for teaching

University	**ESG Perception Index**	**Revenues for teaching**
University of Rome La Sapienza	47,135	116.474.169,55
University of Bologna	41,995	132.888.794,42
University of Turin	41,335	92.923.236,75
University of Milan	38,705	97.150.000,00
University of Florence	35,79	50.460.877,02
University of Padua	34,88	98.455.895,00
University of Pisa	32,41	48.471.696,00
University of Bari	26,07	35.246.086,00
	Correlation	0,8377935

Source: our elaboration

Then, we correlated the ESG Perception Index with revenues from commissioned research and technology transfer. The results highlight a positive correlation with a Pearson's correlation index of 0,50 (tab.6). Compared to the relationship between the ESG Perception Index and other variables, this correlation is the least significant.

Tab.6: Correlation between ESG Perception Index and revenues from commissioned research and technology transfer

University	**ESG Perception Index**	**Revenues from commissioned research and technology transfer**
University of Rome La Sapienza	47,135	14.501.370,11
University of Bologna	41,995	22.309.707,94
University of Turin	41,335	4.705.986,74
University of Milan	38,705	-
University of Florence	35,79	10.517.097,14
University of Padua	34,88	14.578.013,00
University of Pisa	32,41	6.690.580,00
University of Bari	26,07	665.637,00
	Correlation	0,502369820

Source: our elaboration

Finally, we correlated the ESG Perception Index with research and teaching staff costs. Pearson's correlation index emerged is 0,86 (tab.7).

Tab.7: Correlation between ESG Perception Index and research and teaching staff costs

University	**ESG Perception Index**	**Research and teaching staff costs**
University of Rome La Sapienza	47,135	310.456.376,40
University of Bologna	41,995	279.105.847,12
University of Turin	41,335	191.027.488,80
University of Milan	38,705	189.531.111,18
University of Florence	35,79	169.272.074,49
University of Padua	34,88	228.765.076,00
University of Pisa	32,41	145.083.892,00

University of Bari	26,07	124.867.840,00
	Correlation	0,854674911

Source: our elaboration

From the previous analysis, it is possible to state that the most significant correlation is between the ESG Perception Index and the number of enrolled students, with Pearson's index closer to 1 than other variables.

Lastly, we carried out a content analysis on the 2020-2021 sustainability reports, to validate the results of previous correlations. The first step was the calculation of the number of times the words indicated in the methodology section were used for each of the following topics: environment (E), social (S), governance/transparency (G/T), and sustainability (Sus.). Then, we aggregated the results to understand the total value that emerged from the analysis and we correlated it with the ESG Perception Index, obtaining a positive correlation with a Pearson's index of 0,78 that confirms our previous findings. The University of Bari was excluded from the sample because the last document available refers to 2017 (tab.8).

Tab.8: Correlation between ESG Perception Index and content analysis on sustainability report

		Content analysis on sustainability reports				
University	**ESG Perception Index**	**E**	**S**	**G/T**	**Sus.**	**Total**
University of Rome La Sapienza	47,135	30	223	7	245	505
University of Bologna	41,995	80	283	19	132	514
University of Turin	41,335	12 2	63	40	360	585
University of Milan	38,705	84	39	31	186	340
University of Florence	35,79	65	76	21	121	283
University of Padua	34,88	1	4	1	32	38
University of Pisa	32,41	38	50	6	158	252
University of Bari	26,07	NOT AVAILABLE				
		Correlation			**0,777785709**	

Source: our elaboration

5 Conclusions

ESG factors became drivers able to affect companies' performance and are a considered source of competitive advantage (Eccles and Serafeim, 2013) and stakeholders, like investors, consumers, suppliers, employees, public powers, and

non-governmental organization require more sustainable practices from companies (Kolk and van Tulder 2010; Duque-Grisales and Aguilera-Caracuel 2019; Russo et al., 2021; Schimperna et al., 2022). In the current scenario, universities play an essential role in the path towards sustainability, contributing to the achievement of the 17 SDGs of the 2030 UN Agenda. Indeed, universities provide students with knowledge about sustainability, ethical values, and human rights, carry out research about ESG and sustainability, and promote principles and values through the improvement and development of their management and community outreach (Hernández and Saldarriaga, 2009; Schimperna et al., 2022). Thus, the perception of the relevance of sustainability and ESG issues fosters the universities to make investments and innovate their own missions, providing also non-financial disclosure (del Mar Alonso-Almeida et al., 2015; Hernández García de Velazco et al., 2020).

In the light of these considerations, we tried to understand if the ESG factors, considering their perception, can affect the performance of universities. Our analysis was based only on the Italian mega-universities and relied on the ESG Perception Index for the period June-October 2021. We carried out a multi-stakeholder analysis to understand if there is a correlation between the ESG Perception Index and economic variables related to the following three categories: i) students; ii) professors; iii) the Ministry of Higher Education. Our findings show a positive correlation between the ESG Perception Index and the following variables: i) number of enrolled students (0,931142994); ii) Total Ordinary Financing Fund for Universities basic quota (0,885331221); iii) revenues for teaching (0,8377935); iv) revenues from commissioned research and technology transfer (0,502369820); and v) research and teaching staff costs (0,854674911). Lastly, we developed a content analysis of universities' 2020-2021 sustainability reports, obtaining a positive correlation of 0,777785709 that validated our results.

However, this research has the following three main limitations: i) it only considers the ESG Perception Index; ii) it is limited to only Italian mega-universities; iii) it was carried out by considering only one year.

The next steps of future research will be the overcoming of these limitations and the development of a more comprehensive analysis of possible ESG-related impacts on universities, in order to investigate more extensively this research field. Moreover, other efforts will be made to provide cross-country comparisons.

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The Scenario of Economic Policy Uncertainty and Financial Innovation in Visegrad Economies: A Systematic Literature Review

Arif Ibne Asad*

Department of Economics,
Faculty of Management and Economics
Tomas Bata University in Zlin, Czech Republic.

Abdul Quddus

Department of Finance and Accounting
Faculty of Management and Economics
Tomas Bata University in Zlin, Czech Republic.

Drahomíra Pavelková

Department of Finance and Accounting,
Faculty of Management and Economics,
Tomas Bata University in Zlin, Czech Republic.

* *Corresponding author*

Abstract

The importance of the impact created by different uncertainties in the policies on the overall economy of a country or a region cannot be denied. The Visegrád Group (V4 countries, including the Czech Republic, Hungary, Poland, and Slovakia) has certain political and cultural alliances and a significant economic influence in both central Europe and the European Union. The researchers conducted a systematic literature review on the background of economic policy uncertainty and financial innovation in Visegrad economies to understand the real fact of economic uncertainty in financial innovation in this region. The PRISMA 2020 framework has been updated to extract more detailed and accurate systematic literature reviews that were previously ignored and 22 papers have been finally selected to have the results. The common characteristics of these economies are in their transition from planned to market economies, particularly in Slovakia and the Czech Republic. In the common background of these economies, fiscal policy uncertainties, stock market volatility, exchange rate fluctuations, and political uncertainty are also responsible for the EPU. However, a significant influence is that the rapid innovation priority and emphasis on R&D development help the economy to rapidly converge with the EU economies stream.

Keywords – Economic Policy Uncertainty, Financial Innovation, Visegrad Economies, Systematic Literature Review

Nature of proposed paper - Academic Research Paper

1 Introduction

The four Visegrad countries – the Czech Republic, Hungary, Slovakia, and Poland – have many similarities, particularly when compared to other transition economies in Eastern Europe and the former Soviet Union. They are more developed than most other communist countries, have a similar history and traditions, and lead the way in initiating reforms among post-communist countries. They have also consistently performed significantly better than the majority of transition economies, and are currently among the leading contenders for EU membership. However, there were significant differences between the Visegrad countries in terms of initial conditions, transition paths chosen, and resulting economic developments. As a result, the Visegrad group is an ideal candidate for comparative research into the effects of economic policies on financial performance or economic innovation, (Fidrmuc, Fidrmuc, & Horvath, 2002), (Zybała, 2019).

Economic policy uncertainty (EPU) is a risk that occurs when government policies and regulatory frameworks are ambiguous for the foreseeable future. Because of the market's uncertainty, this phenomenon may induce businesses and individuals to postpone spending and investments. Increases in the cost of capital in the economy are exacerbated by increases in economic policy uncertainty. As a result of the irreversibility of investment, increased economic policy uncertainty reduces investment. Economic policy uncertainty raises the value of the decision to wait because investment reversibility affects investment and innovation. Taking this into account, business innovation is essential to capture the potential risks posed by EPU.

This is the research's main goal, using V4 economies as the purposive selection. The justification for this geographical selection is that the world uncertainty index (2021) data still shows the volatility in uncertainty measurement of these economies. The researchers are conducting a systematic literature review on the background of economic policy uncertainty and financial innovation in Visegrad

economies to understand the real fact of economic uncertainty in financial innovation in this region. The study is significant because it will offer pertinent information for the V4 economies' uncertain economic policies and it will enable policymakers to have a comprehensive understanding of such a group of economies.

2 Materials and Methods

This study employed a systematic literature review method (Denyer, & Tranfield, 2009). Our study adopted inclusion and exclusion criteria after constructive reviewing articles from Web of Science and Scopus databases with key terms " Economic policy Uncertainty in Visegrad Economies ", " Economic policy Uncertainty in Respective Economies (Czech Republic, Slovakia, Poland and Hungary", " Uncertainty in Financial Innovation in Visegrad Economies", and " Uncertainty in Financial Innovation in Respective Economies (Czech Republic, Slovakia, Poland and Hungary) during the period from 1992 to 2022.

This study finds 577 papers as records1 on " Economic policy Uncertainty in Visegrad Economies ", and " Economic policy Uncertainty in Respective Economies (Czech Republic, Slovakia, Poland and Hungary". In addition, it finds 563 records on " Uncertainty in Financial Innovation in Visegrad Economies", and " Uncertainty in Financial Innovation in Respective Economies (Czech Republic, Slovakia, Poland and Hungary).

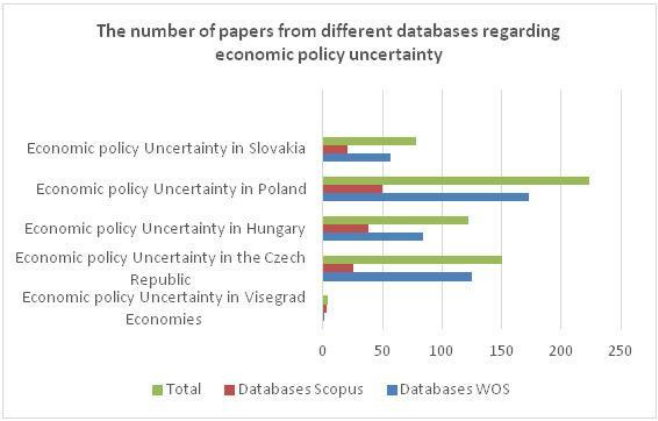

Figure 1: The number of papers from different databases regarding economic policy uncertainty

[1] *Records are the title or abstract (may be both) of a report indexed in website or data ba*

For this evidence-based research, the researchers would like to use the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, which uses a small number of items to describe systematic reviews and meta-analyses. In recent years, highly cited literature from the Web of Science, Scopus, and Google Scholar databases has been used for this purpose (2010-2021). The PRISMA 2020 framework has been updated to extract more detailed and accurate systematic literature reviews that were previously ignored.

A total of 1140 records[1] are obtained on the concerned topic with the other sub-topic mentioned. We employed the Excel software for this purpose, which we used as a manual perspective, because of duplication and other reasons. The study will be conducted through three stages of the PRISMA framework, such as identification, screening and eligibility, and inclusion.

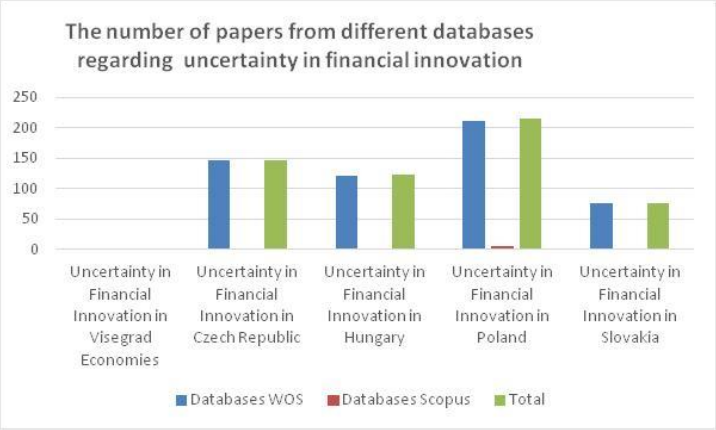

Fig.2 The number of papers from different databases regarding uncertainty in financial innovation.

We employed the Excel software for this purpose, which we used as a manual perspective, because of duplication and other reasons we removed 230 records before the screening. As a result, 910 records are now ready for screening, which can be done in two ways: one by title and abstract, and the other by the full text of the records. First, we eliminate the 568 titles and abstracts that are identical; secondly, after screening the entire text of the remaining 342 reports2, we decided to remove 256 papers because the concepts are similar. We have 86

[2] *Reports are documents on particular study, such as jornal article, conference paper, dissertations and others.*

reports for eligibility purposes, and we have decided to exclude some of them due to a lack of clarity, non-compliance with the V4 economies framework, and a lack of business and economic, and financial ideas, as some papers only focused on this particular issue but very old information in nature. Finally, we chose 22 papers for our literature assessment, five of which are studies[1], and the others are reports.

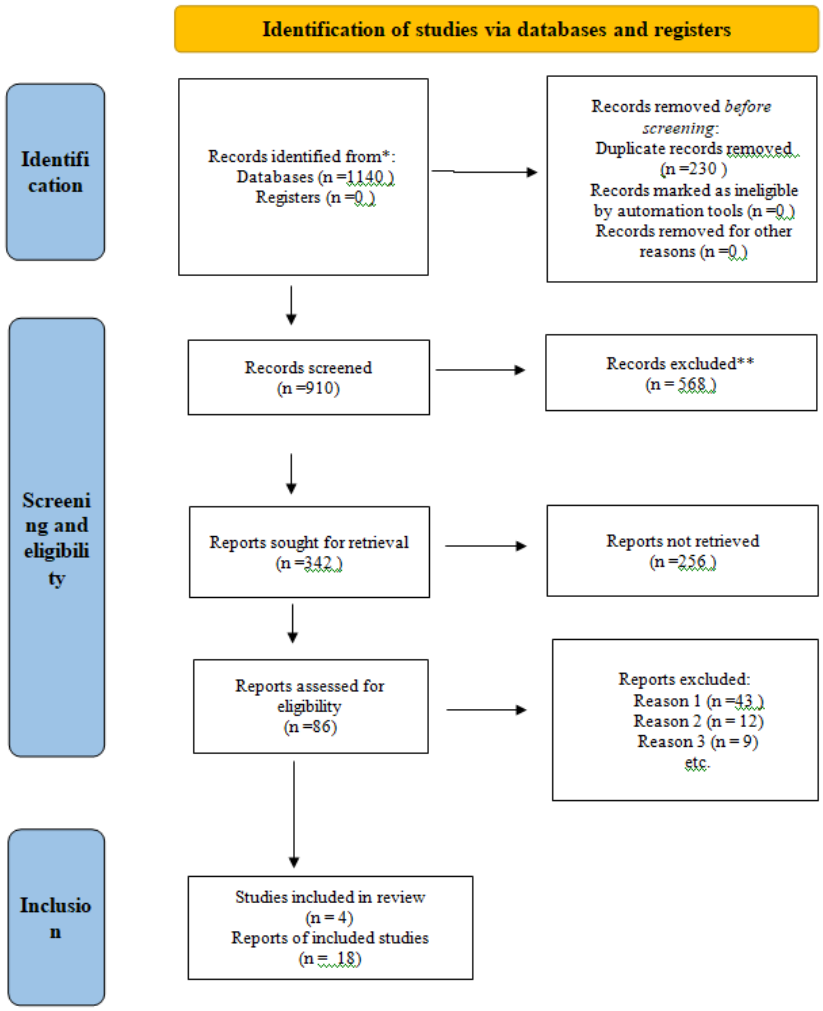

Figure 1: Flow chart: The PRISMA Framework

[1] *Studies are investigations, such as clinical trial, primary outcome, statistical analysis plan, and others*

3 Results and Discussions

Economic Policy Uncertainty in Visegrad Economies has been discussed in each country separately to establish a common background for the study.

3.1 Slovakia

Slovakia has a mixed economic system with a mixture of private freedom and centralized economic planning and government regulation. Slovakia is a European Union member (EU). The transition from a supply-constrained centrally planned economy to a demand-constrained market economy represents a search for an acceptable relationship between growth and a balanced economy from a macroeconomic standpoint. Conditions related to insufficient restructuring and a distorted institutional framework have exacerbated this. Slovakia appears to have completed this transition successfully. However, opportunities for economic growth based on stimulating the economy's demand side have been exhausted (Marcincin, & Beblavy, 2000). Slovakia is an intriguing example of a country with high economic growth but low levels of Research, Technological Development, and Innovation (RTDI) development. A slew of economic and social reforms implemented between 1998 and 2005, as well as cheap and educated labour, aided in attracting a large amount of FDI to manufacturing industries. However, by 2006, Slovakia had become more of a processing economy than a knowledge-based one. The Slovak government's priorities are shifting. It developed several innovation policy concepts (for example, the Competitiveness Strategy) and directed more financial resources toward RTDI activities to avoid becoming a low-cost, low-value-added country. FinTech should include any financial innovation, regardless of the technology used; these innovations should result in new business models, applications, processes, or products that significantly impact financial markets, financial institutions, and financial service providers. Payment services, banking, and insurance are the areas with the greatest potential for financial innovation growth, with numerous innovative products and technological solutions already in place (Ministry of Finance of the Slovak Republic, retrieved in 2023). The study of Jasova, (2019) discussed EPU as especially true in 1999 when Central European countries were transitioning from a planned social and economic system to a market economy. This was followed by a period between the turn of the years 2008 and 2009 when Slovakia experienced a more moderate phase of the financial crisis than the United States. The opposite

occurred at the turn of 2009 and 2010, when Slovakia did not see such a significant decrease in business uncertainty as the US economy, with even an annual increase observed in one quarter.

Table 1: The Reasons for Economic policy uncertainty and Impacts in Slovakia

Author/s	**Reason of EPU**	**Impact/s**
Marcincin, & Beblavy, (2000).	Transformation of the economy- socialism (planned economy) to capitalism (market economy).	insufficient restructuring and a distorted institutional framework, economic growth based on stimulating the economy's demand side have been exhausted.
Jasova, (2019).	Transformation of the economy.	In 2008 and 2009 Slovakia experienced a more moderate phase of the financial crisis.
Ministry of Finance of the Slovak Republic, retrieved in (2023).	Transformation of the economy.	low levels of Research, Technological Development, and Innovation (RTDI) development
OECD (2022).	Fiscal Economic Challenges.	Rapid population ageing causes high government spending.
Vondrová, & Valach, (2014).	Determining economic policy priorities	Ensuring quality economic growth along with quantity growth
Sum, (2012)	Economic policy uncertainty in Europe	Hardly any impact on the Slovak stock market performance

Source: Authors (2023)

According to OECD (2022) report on "Slovak Republic Economic Snapshot: Economic Forecast Summary (November 2022)", Following a deep recession in 2020, economic activity has begun to recover. However, supply disruptions and a low vaccination rate make the recovery's future pace uncertain. An ambitious recovery plan and significant inflows of EU funds present a once-in-a-lifetime opportunity to strengthen the economy, but effective and timely implementation will necessitate ongoing efforts to improve public procurement and public investment management. Rapid population ageing will exacerbate fiscal challenges and weigh on long-term growth in the medium term. Pension, health and long-term care, and labour market reforms are required to extend working lives, improve the health of the ageing population, and increase the efficiency of government spending to prepare for an ageing society. At the same time, population ageing emphasizes the need for increased productivity. Policies to

promote adequate skills, foster domestic innovation capacity, and better price environmentally harmful activities are required to reenergize the economic convergence process and make growth more inclusive and sustainable. Policies to promote adequate skills, foster domestic innovation capacity, and better price environmentally harmful activities are required to reenergize the economic convergence process and make growth more inclusive and sustainable. In addition, Vondrová, & Valach, (2014) emphasized determining economic policy priorities to ensure quality economic growth along with quantity economic growth. The quantitative dimension of economic growth, as measured by GDP, is necessary but not sufficient in the global economy to express the qualitative development of the economy and society. Statisticians and economists recognized the need to provide policymakers and civil society with a dependable, timely, and credible indicator that can quantitatively and qualitatively assess the current situation and forecast future economic growth. The Better Life Index is the most recent international attempt to present the best of a range of a comparable and comprehensive set of indicators of well-being, leading to the attempt and discovery of a better way to measure growth and identify key aspects necessary for prosperity. These aspects must be understood and applied in decision-making processes for determining economic policy priorities and objectives to ensure not only the quantity but also the quality of economic growth, and thus the quality of life. There are some optimistic experiences from the Slovakian economy and one of them is changes in economic policy uncertainty in Europe negatively affect all stock market returns in the European Union, Croatia, Norway, Russia, Switzerland, Turkey and Ukraine, and the effect is statistically significant for all countries except Croatia and seven members (Bulgaria, Estonia, Latvia, Lithuania, Malta, Slovakia and Slovenia) of the European Union.

3.2 The Czech Republic

The Czech Republic's economic freedom score is 71.9, placing it 21st in the 2023 Index. Its score is 2.5 points lower than last year. The Czech Republic is ranked 15th out of 44 countries in Europe, and its overall score is higher than the regional and global averages. The Czech Republic has developed a modern and flexible economy and performs above world averages in many of the four pillars of economic freedom. Open-market policies have allowed the economy to capitalize even more on regulatory efficiencies gained through previous reforms

(Index of Economic Reform, 2023). The Czech National Bank (CNB) recognizes the innovation potential based on the application of digital technologies to streamline the functioning of all sectors of the financial market, improve its financial service provision, and foster a stronger and more resilient Czech Republic real economy. As a result, the CNB has decided to develop a new specialized communication channel to handle FinTech-related inquiries from all financial market participants. The FinTech contact point is the title given to the new channel. Through more active communication with incumbent institutions and potential new entrants, the contact point aims to promote the introduction of innovative technologies in the Czech financial market, (Czech National Bank, retrieved on 2023). When it comes to mean causality, the Czech Republic, Greece, Hungary, Poland, Qatar, and Turkey are more open to EPU. In the Czech Republic, researchers can easily see that EPU predictability is higher in the upper quantiles between 0.60-0.85, implying that EPU is more causal in rising market states (Das, Kannadhasan, & Bhattacharyya, (2019).

Table 2: The reasons for Economic policy uncertainty and its impacts in the Czech Republic

Author/s	**Reason of EPU**	**Impact/s**
Das, Kannadhasan, & Bhattacharyya, (2019).	asset prices in the emerging stock markets volatility	EPU is more causal in rising market states.
Index of Economic Reform, (2023)	Open market policies through the economic reform strategy	Capitalize the economy efficiently.
Czech National Bank (2023)	Innovation for economic development	FinTech-related development from all financial market participants.
Nestoroska, (2020).	EPU and firm performance	EPU has an overall negative impact on firm performance, the interest rate has a positive impact on firm performance and inflation is only positive when the net profit margin is used as a proxy for firm performance.
Julio, & Yook, (2012).	Political uncertainty causes EPU	Firms cut investment until the electoral uncertainty is resolved.
Békesová, & Bohdalová, (2022).	EPU due to exchange rate change	USD/EUR has a significant impact on the exchange rate returns

Source: Authors (2023).

Nestoroska, (2020) obtained results from various non-financial firms in the Czech Republic regarding EPU and firm performance in the Czech Republic. These findings indicate that EPU has a significant and negative impact on firm performance, whereas interest rates have a significant and positive impact on firm performance. However, the impact of the inflation rate is significant and positive only when the net profit margin is used as a proxy for firm performance. Based on these findings, it is possible to conclude that non-financial firms in the Czech Republic must develop policies and regulations regarding precautionary measures that can be taken in the event of EPU to maintain the firm's financial performance. In addition, political uncertainty causes firms to cut investment until the electoral uncertainty is resolved. These findings from Julio, & Yook, (2012) imply that political uncertainty is a significant channel through which the political process influences real economic outcomes. Moreover, Békesová, & Bohdalová, (2022) examined the effect of uncertainty on the exchange rate returns of the Czech crown, Hungarian forint, and Polish zloty (3 of Visegrad Group exchange rates). The main findings show that the USD/EUR has a significant impact on the exchange rate returns of all the currencies under consideration.

The OECD report (2023) finds out structural reform priorities in the Czech Republic as follows:

- Make the labour market more flexible and inclusive.
- Innovation and digitization: Improve the business environment by increasing R&D investment.
- Policy on the environment: Greener growth should be pursued.
- Reform the pension system and promote longer working lives in the labour market.
- Efficiency in the public sector: Consolidating local government services will increase public sector efficiency.

3.3 Hungary

In 1968, Hungary, in response to slowing economic growth, the government implemented the New Economic Mechanism (NEM). The NEM implemented market-style reforms to rationalize the behaviour of Hungary's state-owned enterprises, as well as the emergence of privately owned businesses. By the end of the 1980s, private business had generated one-third of the gross domestic product (GDP), accounting for nearly three-fifths of services and more than three-

fourths of construction. However, the Hungarian economy failed to meet the challenge of the 1973 global economic crisis. The dramatic price increases for oil and modern technology resulted in a large external trade deficit, which increased foreign debt. Growth slowed and inflation increased, resulting in a period of stagflation.

Table 3: The reasons for Economic policy uncertainty and its impacts in Hungary

Author/s	**Reason of EPU**	**Impact/s**
Das, Kannadhasan, & Bhattacharyya, (2019)	Asset prices in the emerging stock markets volatility	Greater impact on price drops rather than causing volatility.
Mallinguh, & Zoltan, (2020)	Lowest IT budgetary support from the government.	The Hungarian FinTech market tends to lag behind its peers in the central European region.
Bod. (2019).	EPU relates to economic structural reforms	income convergence proved to be uneven and slow, leading to widespread frustration
(Oblath, 2016)	Unnecessary fiscal policy implementation	flat income tax, combined with discriminatory sectoral taxes and dependency on EU funds for fiscal support.
Virág, B. (2018).	Global financial crisis 2008-2009.	high foreign and domestic debt increased the vulnerability

Authors (2023).

The Hungarian FinTech market tends to lag behind its peers in the central European region. The financial sector, which is entirely regulated by the Hungarian government, faces significant challenges in implementing information technology (IT) innovations. More specifically, the banking sector fails to develop game-changing innovations because the country has one of the lowest IT budgetary support levels in the region, with the dominant player (OTP bank) being the only notable active innovator over time. The situation is similar in the insurance industry, the capital market, and asset management. The Hungarian National Bank (MNB) regulation, which only allows banks to lend, discourages FinTech investors from targeting borrowers. On the plus side, there has been a significant increase in online shopping and the use of digital payments because of the increased use of smart handheld devices and digital payments, (Mallinguh, & Zoltan, 2020). In the case of emerging European markets, the causality-in-variance is largely insignificant for Hungary and Poland. This phenomenon

essentially means that in these markets, economic policy uncertainty, geopolitical risk, and the Financial Stress Indicator have a greater impact on price drops rather than causing volatility (Das, Kannadhasan, & Bhattacharyya, 2019). The stirring social and political events of the regime change in 1989/1990 and subsequent periods had a huge impact on the transformation of the Hungarian economy. Hungary entered the European market economy with partial monetization, an overburdened industry, and neglected infrastructure. Worries about external debt and the intention of definitively joining the Western political system dominated economic policy thinking, while social expectations focused on closing the income gap between Hungary and the developed West. Although the establishment of the institutional system of market economy and entry into the Western order was eventually successful, income convergence proved to be uneven and slow, leading to widespread frustration (Bod, 2019). Hungary's GDP growth accelerated to 3.7% in 2014 and was close to 3% in 2015. The reasons for the country's economic performance over the last six years are only partially related to the government's economic policies during that time. Between 2010 and 2013, deleveraging (the reduction of excessive debt at both the macroeconomic and microeconomic levels) harmed growth performance (though the introduction of the flat income tax, combined with discriminatory sectoral taxes, also hampered the country's growth). However, the acceleration in economic growth seen in 2014 is primarily due to "exogenous" factors, specifically unusually large transfers from EU funds (Oblath, 2016).

The Hungarian economy's structural and financing problems were evident long before the 2008-2009 financial crisis. Low labour market activity slowed the economy's growth potential, while high foreign and domestic debt increased vulnerability. The global crisis had severe negative real economic consequences, and the escalating political crisis has hampered effective crisis management. Recognizing the unique nature of the crisis, Hungarian economic policy introduced and implemented a new economic strategy that included both conventional and unconventional elements and was based on the coordinated operation of fiscal and monetary policy. Mutually complementary and sequential steps were able to stabilize the Hungarian economy's financial situation, restart growth, and ensure the smooth operation of financial intermediation; in the meantime, social acceptance of reforms was maintained. However, for economic convergence to be sustainable, a turnaround in competitiveness is still required (Virág, 2018).

3.4 Poland

The terms related to social security and fiscal policy are especially important; uncertainty shocks have long-term effects on unemployment in Poland. Researchers how regional indices can be used to study the impact of uncertainty on local economies (Bartha, & Bontempi, 2022).

Table 4: The reasons for Economic policy uncertainty and its impacts in Poland

Author/s	**Reason of EPU**	**Impact/s**
Bartha, & Bontempi, (2022).	Fiscal policy shocks	Impacts local economy
Soliman, (2020).	Investment in SMEs	Having greater potential in Poland
OECD (2007)	A strategy of applying mixed policies	Boosting science and technology human resources, and improving the innovation system's governance.
Ozcelebi, & Izgi (2023).	stock markets volatility	economic policy uncertainty (EPU) index of the US on the exchange rates and stock returns of Korea, Mexico, and Poland.
Hołda, (2019).	Fiscal policy uncertainty and stock market movements	Affects the corporate assets or financial market
Mroczek-Dąbrowska, & Matysek-Jędrych, (2022).	EPU relates to Brexit	Brexit has caused a visible disruption in the Polish companies operating in British markets.
Guney (2019).	Macro-economic uncertainties on private investment	The real exchange rate, inflation, and growth uncertainties affect private investments negatively in Poland.

Authors (2023).

Poland's innovativeness is primarily perceived through the lens of large business entities, owing to the greater resources that can be allocated to research and development, as well as higher qualifications and human capital associated with a more matched offer of large academic centres operating in areas with greater potential. Furthermore, the persistence of the innovation stereotype understood as breakthrough changes, which are frequently important not only for a given entity but for the entire sector, makes innovative actions in the small and medium-sized enterprise sector deserving of the label "hidden ", (Soliman, 2020).

According to OECD (2007), Poland pursued a policy mix strategy, such as strengthening the scientific and technological foundation, prioritizing excellence and critical mass, increasing the incentives for corporate R&D and innovation, boosting science and technology human resources, and improving the innovation system's governance. However several EPUs can be observed recently in Poland, such as Brexit has caused a visible disruption in the so far fairly unobstructed segue to regional integration. Our research is based on a survey of Polish companies operating in British markets and aims to see how companies responded to the changes caused by Brexit and whether certain groups of companies exhibit similar characteristics in response to the observed uncertainty (Mroczek-Dąbrowska, & Matysek-Jędrych, (2022), Macro-economic uncertainties on private investment (Guney 2019), fiscal policy shocks (Bartha, & Bontempi, 2022; Hołda, 2019).

4 Conclusion

The importance of the impact created by different uncertainties in the policies on the overall economy of a country or a region cannot be denied. The Visegrád Group (V4 countries, including the Czech Republic, Hungary, Poland, and Slovakia) has certain political and cultural alliances and a significant economic influence in both central Europe and the European Union. Importantly, post-covid years are attempting to overcome the prior policy uncertainties to sustainably strengthen economic conditions. Slovakia is an intriguing example of a country with high economic growth but low research, technology, development, and innovation levels. Where the Czech Republic invested in innovation based on the application of digital technologies to streamline the functioning of all sectors of the financial market, improve its financial service provision, and foster a stronger and more resilient Czech Republic real economy. However, the Hungarian FinTech market tends to lag behind its peers in the central European region. Finally, the study found out that Poland's innovativeness is primarily perceived through the lens of large business entities, owing to the greater resources that can be allocated to research and development, as well as higher qualifications and human capital associated with a more matched offer of large academic centres operating in areas with greater potential

To understand the true nature of economic uncertainty in financial innovation in the Visegrad economies, the researchers conducted a systematic literature

review on the background of economic policy uncertainty and financial innovation in the Visegrad economies. PRISMA 2020 has been updated to include more detailed and accurate systematic literature reviews that were previously ignored. These economies share characteristics in their transition from planned to market economies, particularly in Slovakia and the Czech Republic. Fiscal policy uncertainties, stock market volatility, exchange rate fluctuations, and political uncertainty all contribute to the EPU in these economies. However, the rapid innovation priority and emphasis on R&D development have a significant impact on the economy's ability to rapidly converge with the EU.

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Innovation Practices and Knowledge Management in Circular Firms: An Analysis on Italian Experiences

Alessandra De Chiara

University of Naples L'Orientale
Largo S. Giovanni Maggiore, 30
Naples, Italy

Luigi Sergianni[1]*

University of IUSS Pavia
Corso Strada Nuova, 65
Pavia, Italy

Sofia Mauro

University of Naples L'Orientale
Largo S. Giovanni Maggiore, 30
Naples, Italy

Anna D'Auria

University of Naples L'Orientale
Largo S. Giovanni Maggiore, 30
Naples, Italy

* *Corresponding author*

Abstract

The Open Innovation (OI) increases knowledge flows, accelerates the innovation processes and increases the benefits produced by the innovation itself. It is generally considered as a fundamental tool for the development of the circular economy.
In line with this, the aim of this study is to investigate the possible connection between knowledge management (KM) and circular economy (CE), within the open innovation practices.

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To accomplish this aim, we adopted the Grounded Theory (GT) approach to investigate OI practices linked to CE, partnerships and benefits declared by companies.
Italian firms have been adopted as a research context. Those selected for the analysis have started to redesign their production systems or carried out radical innovations to achieve the goal of obtaining the decoupling of economic growth from the depletion of natural resources. The results of the study show that the selected firms apply collaborative innovation practices, confirming the existence of a relationship between OI and the EC. The size does not seem to affect the type of OI, while with reference to the industrial businesses, OI practices are concentrated on few ones.
By far, the OI coupled practices are the most numerous and it emerges that there are more companies that introduce innovation into the external context than those that use the external environment to acquire knowledge. In addition, findings show a difference in the benefits achieved on the basis of the category of partners involved in the innovative initiatives. According to the results, we identified three research hypotheses which will be explored in a second step of the analysis.
The paper deals with an emerging issue and can foster a better understanding of the drivers, in terms of KM practices, for the development of the circular economy through the OI. Although this study is an explorative analysis of a sample of Italian circular firms, it offers academic and institutional implications regarding the debate on the circular economy at a micro-level. Understanding the experiences that companies are already having can represent a further step for the achievement of a new economic model, stimulating and fostering the implementation of the circular economy at a micro-level, and leading to policies that support the development of circular innovation.

Keywords – Circular Economy, Open innovation, Knowledge, Italian firms.

Paper type – Academic Research Paper

1 Introduction

The circular economy (CE) represents a new paradigm aiming at achieving the sustainable development (Bakker et al., 2021; Korhonen et al., 2018; Ghisellini et al., 2016), this differs from the linear economy (LE) (extract, produce, consume) replacing the concept of "end of life" with the so-called 3Rs framework "reduce, reuse and recycling", (Jesus and Jugend, 2023).

The need to reconfigure production processes in a sustainable way, highlighted by numerous international actors, (i.e. OECD, 2011), determined a growing attention to the circular economy (Ghisellini et al., 2016), since, achieving the sustainable development requires the consideration of environmental, economic and social aspects, as well as the interaction between them (FAO, 2002; Ren et al., 2013), and the CE pursues sustainability in all these aspects (Birat, 2015; Ellen

Macarthur Foundation, 2013), operating at micro (companies, consumers), meso (industrial symbiosis networks, eco-industrial parks) and macro (cities, regions, national or global governments) levels (Kristensen and Mosgaard, 2020; Kirchherr et al., 2017).

At the micro level, companies, to answer to the growing demand for circularity, have started to develop circular business models (Ferasso et al., 2020) that manage to increase value for consumers, while solving economic, social and environmental challenges (Bocken et al., 2016). Different categories of actors must cooperate to make the CE model work at each stage of the product life cycle, coordinating innovation activities to understand how to adapt or create new systems to generate circularity (Brown et al., 2020). Circular business models activate products and processes innovation and innovate the company's value proposition (Geissdoerfer et al., 2017). This recalls the Open Innovation approach, that can represent a potential guide for the realization of innovative business models (Jesus and Jugend, 2023) as it increases knowledge flows, accelerates the innovation process and increases the benefits produced by innovation itself (Chesbrough, 2003). The OI appears as a fundamental tool for the development of circular economy initiatives, although the integration and interaction of the two approaches is scarcely investigated, as well as the contribution that can be provided by the OI to a more sustainable economy (Jesus and Jugend, 2023).

In line with the above, the aim of our study is to understand the relations between OI and CE, considering, as a research context, some Italian circular economy companies. To accomplish this aim, we adopted the Grounded Theory (GT) methodology (Jensen and Jankowski, 1991). In detail, in the present paper is presented the first step of the study (exploration phase), that starts from the description of each company to identify the presence of OI practices related to CE practices. In particular, the phenomena to be detected and analysed are the different practices of OI, the different categories of partners and the advantages listed by the circular economy companies.

The research sample is represented by 114 circular companies located in northern Italy. Prior to the empirical investigation, a review of the literature on the concept of Open Innovation and its possible role in the circular economy is presented in the second paragraph. Then, the third paragraph illustrates the methodological process adopted and clarifies the phases of data collection and analysis for the empirical research; in the fourth paragraph the results are presented; finally, in the last paragraph the discussions and implication are

presented, with the identification of three research hypotheses to be deepened in the further phases of the analysis.

2 Open Circular Innovation

The OI breaking with the classic idea of the innovation built within the company walls, represents a new way of innovating that involves the use of ideas, knowledge and technologies both internal and external to the company (Chesbrough, 2006; Lee et al., 2010).

According to the scientific debate, the increasing mobility of talented employees among companies of different countries (that began in the twenty-first century), made it difficult to protect knowledge, favouring the development of OI. However, OI has not to be considered as a defect in the company's innovation process, on the contrary, to date the openness of companies and their innovative process are considered by many to be a necessary aspect for innovation in the market (Bigliardi et al., 2021). In addition, the increase in academic courses number has brought specialist knowledge out of research centres (Chesbrough, 2006), favouring the innovation of market dynamics.

It is possible to group OI knowledge flows into: outside-in, inside-out and coupled. The outside-in knowledge (also called inbound knowledge flow) involves the search for knowledge outside the company to expand the internal one, so as to improve the innovative capacity of the company (Chesbrough, 2017; Enkel et al., 2009); on the contrary, the inside-out knowledge (also called outbound knowledge flow) provides to bring the knowledge out of the company's walls by making it available to the external environment. This could occur through technological license agreements or the creation of start-ups and spin-offs, can also represent an additional source of profit from business knowledge otherwise fruitless for the company or in any case with a return lower than that thus generated (Barham et al., 2020). Finally, the coupled open innovation (combining knowledge inflows and outflows) is characterized by the simultaneous presence of outside-in and inside-out knowledge flows (Enkel et al., 2009).

OI practices have also been described as a useful tool for overcoming obstacles to the CE (Jesus and Jugend, 2023). Innovation is central to drive the transition to a circular economy and a sustainable development (De Jesus and Mendonça, 2018), and to generate reuse circuits (through restructuring and reproduction), recycling processes (reconstruction of inputs and remodelling of outputs) and

renewal initiatives (using clean energy and eliminating waste), so creating the so-called "eco-innovation" (Sáez-Martínez et al., 2016). Eco-innovation in a circular economy perspective expands the basic concepts, too focused on the final phase of the product's life, and includes waste prevention, sharing/leasing, repair, remanufacturing, and recovery, these concepts also include other stages of the life cycle, such as the design and use phase (EIO, 2016). Bogers and colleagues (2020) describe this kind of innovation as "a distributed innovation process which is based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model, thereby contributing to development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Bogers et al. 2020, 1507).

It is characterized by the objective of reducing, slowing down and closing resource circuits, but clashes with the problem of dispersion of capacities and infrastructures for its realization among the different market players (Blomsma, 2018). Collaboration and knowledge management, therefore, play a fundamental role, as every phase of the product's life and, consequently, each involved actor must adopt a shared approach with partners, innovating together to adapt or create new systems to generate circularity (Brown et al., 2020).

3 Methodology

As mentioned above, the main aim of our study is to propose a model to explain this relationship between OI and CE through the GT method. To accomplish this aim, 114 circular companies located in the northern Italy have been analysed. We decided to consider only companies located in the North of Italy in order to analyse the business choices in circumstances as homogeneous as possible – namely companies belonging to the same territory and cultural context, although from different sectors (Hilgers and Ihl, 2010; Roper et al., 2013; Yun et al., 2020) - having at the same time a large sample.

Has to be underlined that the present paper represents a preliminary phase of the whole research process, namely the exploration phase, since the research process started with the analysis and description of each single company, to detect any reference to the OI. In addition, in this phase will be also introduced three research hypotheses that will be further analysed in the future steps of the

study through the Grounded Theory approach. Survey items of the exploration phase are illustrated in Figure 1.

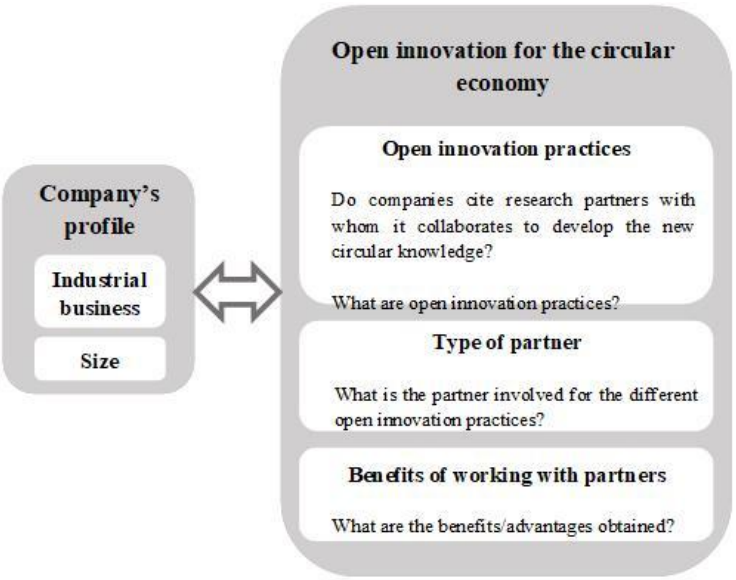

Figure 1: Survey items

3.1 Data collection

Data are mainly collected from the Italian Atlas of the circular economy website (www.economiacircolare.com), namely an interactive web platform, created by the Environmental Conflict Documentation Center of the Association Sud (www.asud.net) with the support of Erion, and born from the experience of two Italian WEEE consortia (waste from electrical and electronic equipment).

The Italian Atlas platform has been chosen to collect data since it is considered as a tool to map territorial realities according to the circular economy initiatives implemented by local firms and it is continuously updated through the monitoring of a scientific committee.

We selected data related to firms located in the Northern Italy, the most numerous of the Italian firms listed in the Atlas and in particular in the following regions: Valle d'Aosta, Piemonte, Lombardia, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Liguria, Emilia-Romagna Romagna. Data collection lasted 7 months (from May 2022 to November 2022).

The firms are categorized by the region, the business area, the level of circular initiative implemented or planned (circular production model; circular product; secondary raw material; circular service; enabling technology; circular economy research research project), the category (profit; non-profit; research institution; public sector) and the target (B2C; B2B). To avoid any bias and to guarantee the methodological consistency, we chose to collect more data from the official websites of the companies. And, in particular, we collected data on the organizational characteristics, such as the size and the sector in which they operate, and strategic characteristics related to the adoption of the OI approach in implementing CE initiatives, such as the presence of innovative initiatives, the type of OI, as well as the partners with whom the company collaborates, and the related advantages declared.

4 Results

The results show that 72% of the companies analysed apply collaborative innovation practices (Appendix 1), this confirms the relationship between OI and CE. Firms' OI initiatives have been classified according to Chesbrough and Bogers (2014) proposal, namely inside-out, outside-in and coupled process.

Only 6% of the companies realize exclusively outside-in OI collaborations; 22% exclusively realize inside-out OI collaborations, mainly represented by partnerships; finally, 44% of the sample realize coupled OI initiatives.

The size of companies does not affect the kind of initiative implemented (Figure 1): in fact, 60% of large companies, 62% of medium-sized companies, and 69% of small companies declare to implement outside-in OI and coupled OI initiatives; while 100% of large companies, 77% of medium-sized companies, and 92% of small companies declare to implement inside-out OI and coupled OI initiatives.

In general, it emerges that, regardless of size, there are more companies introducing innovation into the external context than those that use the external environment to acquire knowledge. This means that circular innovation does not necessarily have to be driven by large companies, on the contrary, small firms manage to be more profitable in innovation, with special reference to radical innovation (Lee et al., 2010). This suggests a great innovative capacity of companies which represents a research trajectory to be further investigated.

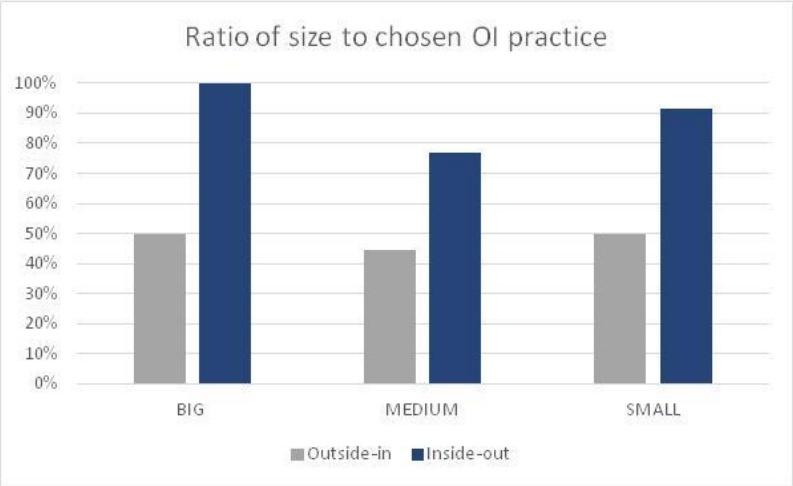

Figure 2: Outside-in and inside-out OI initiatives by firm size

According to the documents we analysed, the benefits deriving from the implementation of OI initiatives are, in descending order: acquisition of new knowledge, encouraging the adoption of a sustainable approach, spreading principles of circular economy, costs reduction, costs sharing, time-to-market reduction (see Appendix 1).

By comparing the benefits and the way in which the OI initiatives are implemented, it emerges that companies that collaborate with different categories of stakeholders have a more diversified portfolio of advantages, managing, in many cases, to acquire new knowledge (69%), spread the principles of the circular economy (54%) and encouraging the adoption of a sustainable approach (73%) (Figure 3).

The second most mentioned aspect is the relevance of the collaboration with different actors in the realization on OI initiatives.

The very logic of OI offers a clear explanation of this phenomenon, where, especially in SMEs, even two competing companies find it more convenient to collaborate and co-create than to close themselves off and not feed the innovative process (Radziwon and Bogers, 2019). The "partner companies" were divided into two groups on the basis of the sector in which they operate, we also paid attention to the selection of partners operating in the same sector. In general, the benefits are very similar, differing only in the frequency with which these benefits occur, lower for the "companies in the same sector" category.

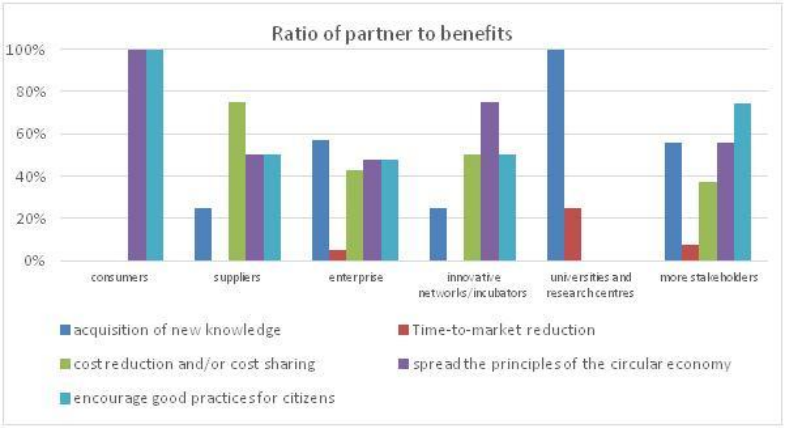

Figure 3: The frequency of benefits in relation to the partner they collaborate with.

The third most mentioned aspect is the relevance of partners as universities and research centres; in fact, 25% companies recognize universities and research centres as the best entities with whom cooperate with special reference to the acquisition of new knowledge; anyway, apart from the acquisition of knowledge, the collaboration with these categories of partners is not considered as very advantageous, least of all to reduce the time-to-market.

The collaborations with other categories of partners are less numerous; for example, only three companies state to collaborate with consumers, declaring, as expected benefits, the dissemination of CE principles and the promotion of good practices for citizens, while collaborations suppliers are considered useful with reference to cost reduction or sharing.

Finally, innovative networks / incubators represent 6% of the categories of partners mentioned, the benefits associated to this category of partners are mainly cost reduction and sharing, as well as the dissemination of circular economy principles and the promotion of good practices for citizens.

As concerns the sectors (Figure 3), companies analysed are mainly from textile, clothing, leather, footwear and accessories sectors (18%), followed by furniture and furnishing companies (12%); finally, companies operating in waste management represent the 11% of the dataset, as well as companies producing secondary raw material, also representing the 11%. Although the dataset does not allow to determine a relationship between the specificities of the various sectors and their influence on the adoption of circular practices and OI, it is nevertheless

relevant that there are sectors not represented at all in our dataset, like “Mobility, transport, and logistics” or “Energy production and distribution”.

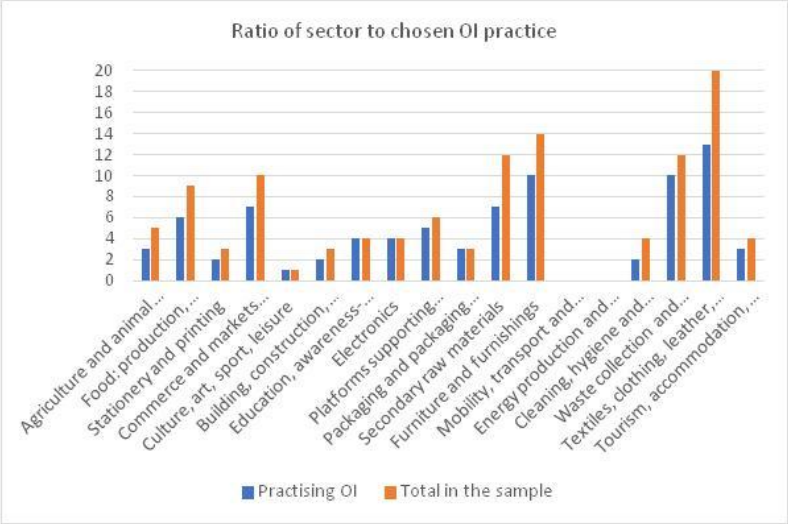

Figure 4: The frequency of realities adopting OI practices in relation to the sector in which they operate.

5 Discussion and implications

The results highlight the existence of links among the different phenomena investigated, within the relationship between OI and CE, this led us to identify three research hypotheses to be explored in a further step of the investigation:

> *H1. The benefit pursued by the company determines the type of IO initiative and the partners to be involved.*

Data show that benefits can change if the partners involved change. Then, would the search for a specific benefit determine the category of partners to be involved in the implementation of OI initiatives? This aspect poses a further question on the presence of specific partners and their willingness to collaborate and share their knowledge and skills.

Our results are aligned with the model proposed by Jesus and Jugend, (2023), representing an empirical confirmation of their study, especially as concerns to the implications/benefits noticed with reference to "consumer awareness" and "organizational performance": in fact, collaborations with consumers have as main effect the dissemination of a new awareness, while the collaboration with the

different actors brings improvements on the operational performance of the companies.

Interesting theoretical implications derive from the first hypothesis: focusing on the relationship between benefits and partners and investigating this relationship more deeply would shed light on a completely new perspective on the influence of OI and, consequently, of knowledge management in circular companies (Chesbrough, 2003; Brown et al., 2020). This perspective would make it possible to circumvent (1) a possible "internal obstacle" for the company, related to the lack of awareness of the benefits that can be achieved through collaborative forms, and that can favour the development of circular innovation; (2) a possible "external obstacle" related to the presence of partners and their willingness to collaborate. Future studies on the relationship between benefits and partners would make it possible to make the various players aware of the centrality of their role in supporting the birth and development of circular processes: an example is represented by the so-called University's Third-Mission that can support the circular transaction of production systems and, at the same time, obtain rewards for having supported applied research.

Also interesting are the implications for institutions in considering the relationship between IO, partners and achievable benefits: on the basis of these relationships and the benefits to be obtained, institutions would identify the necessary partners. In particular, actions could be put in practice to ensure that the partners are from the same territory and are willing to collaborate; this could be part of a policy for the development of the circular economy. Furthermore, policymakers could intervene in raising awareness and educating the various stakeholders on the circular economy.

H2. Local culture and characteristics of the sector can represent a barrier/stimulus to OI and CE.

In the approach to CE and in the implementation of OI initiatives for circular innovation, our research shows clear differences in the behaviour of companies with respect to the territorial characteristics and industrial business (Hilgers and Ihl, 2010; Roper et al., 2013; Yun et al., 2020). The analysis of the key factors that determine these differences can constitute an interesting research trajectory to understand the influence of OI in circular companies, that could also lead further research on the obstacles to OI and the development of circular innovations in some industrial sectors.

H3. The CE through OI is an opportunity for SMEs.

Small firms manage to be more profitable in innovation, with special reference to radical innovation (Lee et al., 2010). Data show that the size of circular companies does not affect the tendency to carry out more inside-out OI than outside-in OI initiatives. The presence of small innovative firm that adopt an OI approach in implementing CE initiatives, could be useful and perhaps needed for the diffusion of the circular economy in the Italian territory. The debate underlines that the specificity and flexibility of SMEs accelerate innovation (Lee et al., 2010), innovation sharing can represent a relevant business opportunity and a lever for the development of new markets that small businesses can enter.

In conclusion, the phenomena we investigated and the preliminary results emerged from this first phase of the analysis represent a starting point for future investigations to confirm or confute the research hypotheses proposed above. The future steps of the research will be carried on through an empirical analysis adopting the Grounded Theory approach.

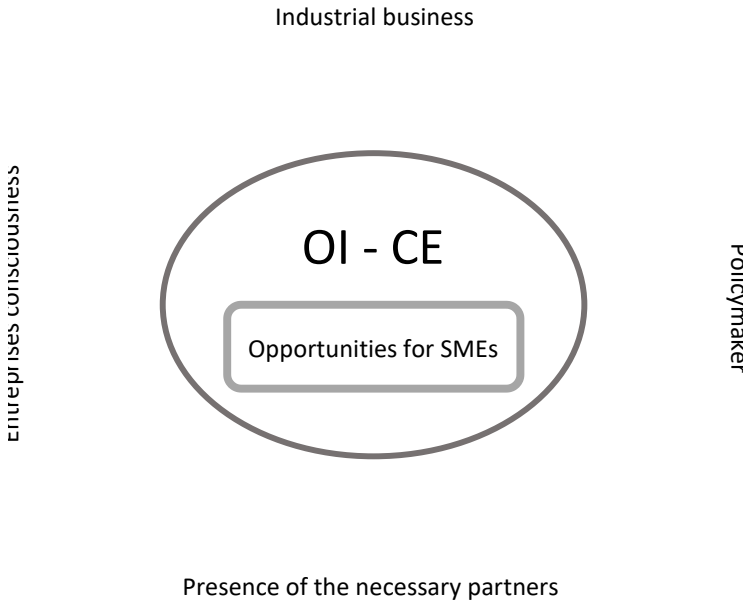

Figure 5: Framework of research hypotheses to develop.

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Appendix 1

Table 1: Authors' elaboration; percentage frequencies are calculated in relation to the total number of firms listed in the dataset.

Region	**Absolute frequency**	**Percentage frequency**	**Dimension**	**Absolute frequency**	**Percentage frequency**
Lombardia	56	49%	Small	82	72%
Liguria	7	6%	Medium	18	16%
Piemonte	9	8%	Large	12	11%
Valle D'Aosta	0	0%	**Open innovation approach**		
Emilia Romagna	18	16%	Outside-in o inbound	7	6%
Friuli Venezia Giulia	5	4%	Inside-out o outbound	25	22%
Trentino Alto Adige	6	5%	Coupled process	50	44%
Veneto	13	11%	None	32	28%
Industrial business			**Partner**		
Agriculture and animal husbandry	5	4%	Consumers	3	3%
Food: production, distribution and redistribution	9	8%	Suppliers	4	4%
Stationery and printing	3	3%	Innovative Networks/ Incubators	4	4%
Commerce and markets (large, medium, and small-scale distribution, second-hand markets, e-commerce)	10	9%	Universities and research centres	29	25%
Culture, art, sport, leisure	1	1%	Venture capital companies	1	1%
Building, construction, renovation	3	3%	More unspecified stakeholders	26	23%
Education, awareness-raising, information, support, and advice	4	4%	Companies in the same sector	25	22%
Electronics	4	4%	Other companies	28	25%

Platforms supporting sharing, networking and exchange of goods and skills and/or mobile applications	6	5%
Packaging and packaging products	3	3%
Secondary raw materials	12	11%
Furniture and furnishings	14	12%
Mobility, transport, and logistics	0	0%
Energy production and distribution	0	0%
Cleaning, hygiene, and cosmetics (household and personal products)	4	4%
Waste collection and management	12	11%
Textiles, clothing, leather, footwear, and accessories	20	18%
Tourism, accommodation, events, catering	4	4%

Open Innovation Benefits		
Acquisition of new knowledge	53	65%
Reduction of time-to-market	9	11%
Cost reduction and/or cost sharing	23	28%
Disseminating circular economy principles	29	35%
Encourage good practices for citizens	35	43%
More benefits	25	30%

Leading and Managing Organizational Resilience

Ilona Toth*

LUT University, Business School
Yliopistonkatu 34
53850 Lappeenranta, Finland

Aino Kianto

LUT University, Business School
Yliopistonkatu 34
53850 Lappeenranta, Finland

Anna-Maija Nisula

LUT University, Business School
Yliopistonkatu 34
53850 Lappeenranta, Finland

* *Corresponding author*

Abstract

There are many types of uncertainties that the contemporary working life – including public and private sector organizations – needs to cope with to operate successfully and to maintain their competitive advantage. Worldwide crises, shortage of labour, and the need to adjust quickly to the changing environment call for a new type of organizational resilience. We propose that in addition to being able to bounce back from adversities, which is the traditional viewpoint for organizational resilience, organizations need to invest in developing their proactive organizational resilience. It is suggested that leadership and management activities play a key role in building and fostering proactive organizational resilience. It is expected that knowledge management practices, such as increasing change capability and creating a continuous learning environment are important elements in improving proactive organizational resilience. As a way of identifying the crucial leadership and management processes in developing proactive organizational resilience, a systematic literature review on recent research literature is currently being carried out. This is still work-in-progress but based on interim results of the systematic literature review, this conference paper presents some key perspectives and discussions together with main research findings. In addition, some interesting future research prospects are described.

Keywords – Organizational resilience, Proactive organizational behavior, Systematic literature review, Management, Leadership

Paper type – Academic Research Paper

1 Introduction

The working life is facing several profound challenges in the near future. A recent report by the Finnish Institute of Occupational Health lists massive shortage of workers, uncertainty caused by recent worldwide crises, and difficulties in operating the welfare state as three most important problems for managing the working life in Finland (Ranki, 2023). It is very likely that Finland is not alone in dealing with these problems. At the same time, the concept of resilience has become the buzz word in popular press along with newspapers and magazines – as well as in academic literature. According to the Scopus database, during the first quarter of 2023, over 6,000 scientific publications dealing with some forms of resilience have already been published.

Resilience belongs to the core constructs of positive organizational behavior (Hartmann et al, 2020). At the individual level, it is a malleable (i.e. developable) capability to bounce back from adversities (Luthans, 2002). Resilient individuals are able to function despite crises and stressful situations. At the organizational level, resilience has traditionally been firmly connected with crisis management (Williams et al., 2017). In contemporary organizational settings, such reactive resilience is not sufficient to guarantee sustained high performance, but a certain amount of proactive change capacity is also needed. Therefore we propose proactive organizational resilience as a multidimensional concept including at least interpreting the current situation, anticipating future events and responding proactively, as well as continuous learning. The goal of proactive organizational resilience is flexibility, not just in reacting to what has happened but in being at least one step ahead of what is going on in the organization and the world around it. While the need for resiliency has been well recognized across many academic disciplines and consequently related research is burgeoning, there seems to be a lack of overarching frameworks focusing on the proactive side of resiliency, especially from a managerial point of view.

Then what is it that we currently do know about leading and managing resilience at the public sector and in private organizations? To answer this question, we are in the process of conducting a systematic literature review on the topic. We are currently going through a set of 333 research articles on organizational resilience which we have identified through a review protocol explained in detail in the methodology section of this conference paper.

The importance of being able to lead and manage resilience proactively has become extremely important for both the public and private sector organizations because they all need to cope with a constant stream of unanticipated large-scale changes, which ultimately shake the very tenets of their existence. Hence all kinds of organizations must be able to make renewals on operational, tactical and strategic levels. The conference paper will contribute to a practical understanding of what are the key facets of leadership and management of a proactive type of organizational resilience. From the academic perspective, the forthcoming paper contributes to building an improved understanding of the current state of the literature concerning proactive organizational resilience and its leadership and management. The paper will outline the key perspectives and discussions in the current literature, methodological choices, and main findings, and will also point out a set of topical future research questions to be tackled.

2 Building organizational resilience

Given the abundance of research articles on organizational resilience, it is surprising how few of them focus on building, that is, leading or managing resilience effectively. Thus, the focus of supporting employees in their attempts to cope has largely been neglected (Richard, 2020). Conceptualizing organizational resilience has been the focus of numerous recent literature reviews but only few of those (Britt et al., 2016, Fisher et al., 2019, Hartmann et al., 2019, Hillman and Guenther, 2021; Koerber et al., 2018; Linnenluecke, 2017; Vanhove et al., 2016) have dealt with resilience with emphasis on the working life context, and even fewer from a proactive viewpoint.

Some researchers argue that to demonstrate resilience requires the presence of adversity (Hartwig et al., 2020). Previously, workplace resilience has been defined as employees' ability to manage and positively overcome adverse events at work (Fletcher and Sarkar, 2013). However, Stoverink et al., (2020) point out that the greatest influence on building organizational resilience takes place before an adversity is imminent. Hartwig et al. (2020) identify three key themes regarding organizational resilience: the dynamic nature of resilience, a positive adaptation to adversity, and a sustained organizational viability. To us, these describe the building blocks of proactive organizational resilience.

Borg et al. (2022) explored how resilience can be built across organizational levels and found that psychosocial mentoring and peer coaching are effective means for bolstering workforce resilience. Vanhove et al. (2016) found in their meta-analytic approach that one-on-one delivery format, such as coaching, was

the most successful method in resilience-building programmes. Therefore, there seems to be a strong link between resilience building and management practices. Nevertheless, in her review of resilience in business and management literature, Linnenluecke (2017) contends that literature has provided contradictory recommendations for how resilience should be built into organizations, and hence the topic is worthy of further inspection.

3 Methodology

The objective of the systematic literature review in this conference paper is to describe what is currently known about leading and managing organizational resilience and what are the main trends suggested for future research. With our research question 'What do we currently know about leading and managing resilience at the public sector and in private organizations?' in mind we created a review protocol with the following criteria. After some initial experimental literature searches, we limited our search on the Scopus database as it offers an extensive coverage of titles publishing research on life, health, and social sciences. We then defined our search criteria to ["organi* resilien*" AND lead* OR manag*] mentioned in the article title, abstract or keywords. This search produced 964 documents initially. As we are interested in the current state of affairs with a focus on managerial activities, we further limited our search to documents published during 2018-2023 and in the subject areas of 1) Business, Management, and Accounting, 2) Social Sciences, and 3) Psychology. This search decreased the number of documents to 399. We finally limited our search to articles or reviews written in the English language thus excluding conference papers, book chapters, and the like, for the purpose of emphasizing peer-reviewed documents. This final limitation brought us down to 333 articles or review articles on organizational resilience.

In the second stage of the literature review process, we omitted articles which were published in journals that have no AJG (Academic Journal Guide) ranking as an implication of research quality and integrity. After this, we carefully went through all the remaining abstracts, excluding articles where lead* or manag* did not refer to organizational managerial activities, where the research focused on nonwork settings, or where the main focus of the article was otherwise off from our research question. The final number of articles to be gone through in detail will be around 70-80. We are currently in the middle of this process, and consequently describe our findings so far, based on 35 articles, in the remainder of this conference paper.

4 Findings

Our findings so far concentrate on three aspects of organizational resilience. We first summarize how organizational resilience has been defined in contemporary research literature. We then proceed by taking a look at key perspectives and discussions and the methodological choices within these current articles and describe their key findings. Finally, we point out some interesting topical future research suggestions.

4.1 Definitions of organizational resilience

The most common definition of organizational resilience deals with the process of recovering or overcoming an adversity. This definition originates from Sutcliffe and Vogus (2003) and has been found in several literature review articles. Along a similar idea is the definition of resilience which describes the ability to bounce back from a setback or failure (originally from West et al., 2009). A more proactive look on defining resilience can be found in Stokes et al. (2019), who describe resilience as the ability to withstand challenges through cultivation of organizational capacities and in McEwen (2022), who defines resilience as being proactive in positioning future challenges.

4.2 Key perspectives, discussions and findings

By far, most of the current research articles on organizational resilience are quantitative in nature. There are also some literature reviews and conceptual papers, but these represent a clear minority.

On the softer side of management activities, well-being oriented human resource management practices increase resilience through influencing group feelings and social climate (Cooper et al., 2019). Leaders also need to personally invest resources that build their own resilience in order to foster resilience in teams they lead (McEwen, 2022). Trust, reciprocity, and clarity play a vital role in cultivating employee resilience (Kakkar, 2019), and a learning organization positively effects employee resilience (Malik and Garg, 2020).

Preparedness to unexpected events and a proactive resilience perspective can be found in Branicki et al. (2018) and Casprini et al. (2023). Mitsakis (2020) adds that strategic human resource development is a proactive response to unexpected events.

Several scholars conceptualize organizational resilience through an adaptive capability for internal or external organizational alignment (e.g. Mithani, 2020;

Chowdhury et al., 2019; Martinelli et al., 2018) which results in bounce-back or bounce-forward (proactive) resilience. Leadership can support organizational resilience by fostering a belief in group capabilities (Fernandez et al., 2022).

A process perspective to organizational resilience is introduced in several articles. According to Yang et al. (2021) there are three phases: preparation, response and development, while Akgün et al. (2022) list anticipating, preparing for, responding, and adapting as the four phases of this process. Finally, Mithani (2020) sees five phases, those of avoidance, absorption, elasticity, learning, and rejuvenation.

Branicki et al. (2018) make a difference between everyday resilience and resilience in extreme conditions and bring into discussion micro-processes that link individual resilience and organizational resilience. Finally, managerial resilience is seen as collective persistence and recovery (Ranucci and Wang, 2022).

4.3 Future research questions

A few articles call for new resilience measures in response to the fast-changing context of work. In addition, the role of contextual or organizational practices in explaining resilience (Hartwig et al., 2020) needs clarification. On the softer side, looking at optimism, cynicism and humour in connection with resilience (Stokes et al., 2019) adds to the trend of seeing personal resources as building blocks of not just employee resilience but also organizational resilience.

5 Conclusions

This paper addressed the highly topical issue of organizational resilience with the aim to better understand how organizational resilience can be supported by leadership and management activities. We discussed the need to approach organizational resilience not only as the ability to recover from emergencies and crises (Lee et al. 2013), but also as the ability to proactively renew the organization (Välikangas, 2010). In specific, this paper examined leadership and management of proactive organizational resilience by exploring the current research knowledge on the topic with systematic literature review method.

As the systematic literature review process is still ongoing at the time of writing this conference paper, we reported the interim results. They demonstrate that while many research articles still define organizational resilience reactively as bouncing back from adversities, there are several scholars who call for a more proactive approach to organizational resilience. Many scholars emphasize

adaptive capabilities as a key resource for organizational resilience. Well-being, trust, and in general a positive learning environment are suggested as human resource management-oriented practices to foster proactive organizational resilience.

There are some limitations in this literature review. First, we only looked at a limited number of articles through a single database, and it is likely that we have overlooked some relevant articles. We are in the process of rectifying this shortcoming in our review by updating our reading list as we proceed with the original articles. It is probable that if an article is cited several times in the articles we have so far read, it is worth looking into by us as well. Second, we are still in the original stages of our systematic literature review and have thus far benefited little from researcher triangulation. However, in the next stage of our review process we will jointly go through and discuss the relevance of our findings so far.

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Knowledge Management and Leadership Development Methods for Agile Healthcare Organizations

Vasja Roblek

Faculty of Organisation Studies in Novo Mesto,
Ulica Talcev 3 8000 Novo Mesto, Slovenia

Vlado Dimovski

School of Economics and Business
University of Ljubljana
Kardeljeva ploščad 17, 1000 Ljubljana, Slovenia

Kristjan Jovanov Oblak

Diagnostic Centre Bled
Pod skalo 4, 4260 Bled, Slovenia

Maja Meško

Faculty of Organization Sciences
University of Maribor
Kidričeva cesta 55a, 4000 Kranj, Slovenia

Judita Peterlin*

School of Economics and Business
University of Ljubljana
Kardeljeva ploščad 17, 1000 Ljubljana, Slovenia

** Corresponding author*

Abstract

The increasing importance of agility in healthcare organizations and the fact that there are no studies in the field of agile management in healthcare in Slovenia led us to the decision to prepare research that includes a Delphi study on the importance of adopting agile and flexible business models based on the digital transformation of business in Slovenian health organizations. Knowledge management ensures long-term quality care and provides support in the decision-making process. Most of the knowledge that healthcare professionals learn during their training needs to be renewed during their working period, which is why they need to be agile in their thinking and behavior. The fundamental goal of the study is to answer the research question, what organizational changes need to be implemented in Slovenian healthcare organizations to develop the foundations for

creating an organizational culture that will enable the emergence of organizational agility in Slovenian healthcare organizations in the future? The research is focused on organizational adoptions and changes that are necessary for the healthcare organization to become agile. The purpose of this exploratory study is to investigate the consensus among employees in healthcare organizations regarding new pragmatic approaches based on knowledge management that will enable the implementation of organizational culture. We are interested in researching the evolution of organizational agility, where we will discuss organizational culture, models of organizational culture, and the changes it is currently under. We also emphasize how to overcome the resistance towards change to enable acceptance of agility in healthcare organizations. We describe agility as a competence that enables innovation. We highlight the factors that influence a healthcare organization's agile functioning. Our research objective is to present a finished study of knowledge management, and agility management in healthcare organizations.: The methodology used is the Delphi method. Our research empowers healthcare professionals with new management and leadership concepts, such as agile management, and different leadership development methods in healthcare. Sustainable leadership influences healthcare organizations' distribution of human and financial resources. The impact of sustainable leadership is leading healthcare organizations and their stakeholders towards sustainable development according to UN Global Goals. However, this is many times challenging to do. The emergence of a new organisational culture will also contribute to the efforts of employees, which are necessary to ensure the successful transformation of a healthcare organization into an agile one.

Keywords – Agility, Knowledge Management, Leadership Development, Sustainable Leadership

Paper type – Academic Research Paper

1 Introduction

In theory and modern managerial practice in healthcare organizations, the question arises as to why organizational agility is important for healthcare organizations and its role. Based on analyses of texts by authors such as Kitzmiller (2006), Mak et al. (2020), Marashi and Hamidi (2018), and Moon (2020), it can be concluded that organizational agility is a concept that enables healthcare organizations to adapt their operations to disruptions and remediate their consequences faster. In practice, healthcare organizations must be prepared for: the adoption of technological changes, the emergence of digital transformation, changes within the healthcare supply chain, disease outbreaks and crises such as the one caused in the healthcare system by Covid-19, changing customer needs, competitor responses, and regulatory guidelines. The agility concept aims to ensure that implementing changes does not require a complete restructuring of the organization.

What organizational agility means for a healthcare organization is easiest to demonstrate based on the evolution of the concept and with theoretical examples from production organizations. Organizational agility initially became a critical factor that points to how competitive an organization is and whether this enables it to survive in more volatile market conditions. After 2000, the importance of agility in the organization also moved to the individual, strategic, and organizational levels. Agility is thus in the second decade of the 21st century. has become a complex research area. It is going about research in the field of agility in areas such as management, business logistics, marketing, computer science, business information systems, digital transformation, and increasingly also healthcare (Stenbeck and Mix, 2019). Hoelbeche (2018) justified the fundamental mission of agility as encouraging the organization to learn and discover changes in the environment as opportunities, respond to them quickly, and use them to its advantage, which gives the organization a competitive advantage in the market. More and more studies are focusing on researching the importance of agility in the service sector, as in our case, healthcare. In 2006, Kitzmiller and co-authors (2006) pointed out that adopting an agile concept in a clinical system improves the implementation of a conventional process implementation plan. Pipe et al. (2012) believe that resilience and agility are increasingly valuable in a healthcare environment that is changing rapidly and unpredictably. Davies and Drake (2007) surveyed home care in the UK. They found that it was only awarded to those providers who met strict criteria and met the selection criteria and were able to introduce significant organizational changes that have resulted in the quality and increased range of services offered and increased agility. Krishnamurthy and Yauch (2007) suggested that it is necessary to analyze essential dimensions in the healthcare field, within which the authors classified social systems, organizational culture, and employee attitudes.

The increasing importance of agility in healthcare organizations and the fact that there are no studies in the field of agile management in healthcare in Slovenia led us to the decision to prepare research that includes a Delphi study on the importance of adopting agile and flexible business models based on the digital transformation of business in Slovenian health organizations.

The fundamental goal of the study is to answer the research question, what organizational changes need to be implemented in Slovenian healthcare organizations to develop the foundations for creating an organizational culture that will enable the emergence of organizational agility in Slovenian healthcare organizations in the future?

The research is focused on organizational adoptions and changes that are necessary for the healthcare organization to become agile. The purpose of this exploratory study is to investigate the consensus among employees in healthcare organizations regarding new pragmatic approaches based on knowledge management that will enable the implementation of organizational culture. The goal of developing and implementing an organizational culture must be based on the fact that it must positively influence the development of the phenomenon of an agile healthcare organization. The emergence of a new organisational culture will also contribute to the efforts of employees, which are necessary to ensure the successful transformation of a healthcare organization into an agile one (Jovanov Oblak, 2022).

2 Methodology

2.1 Delphi study and scenario planning

Using the Delphi study, we set out to investigate the development of the organizational culture model in Slovenian healthcare organizations until 2027. The very purpose of the research is to obtain insight into the state of the organizational culture and subsequently determine what changes would be necessary for organizations to achieve an agile business model or transform from classic to agile organizations. The empirical results obtained in this way allow us to build a scenario for the most likely future of changes in organizational culture, to ensure the successful implementation of agility concepts in the context of medium-term strategic planning. Created scenarios will serve managers in preparing new strategies and challenging already established ones. Researchers can use the scenarios as a starting point for further studies on the development of organizational culture, which enables and ensures the transformation of a healthcare organization from classical to agile.

As part of the Delphi study, we designed a questionnaire. A questionnaire is based on predicting future scenarios of the development of organizational culture and organizational agility. The future is considered uncertain and often unpredictable. Part of this uncertainty is technological development, which increasingly dictates the speed and pace of organizational change. Thus, there is an increasing need for all stakeholders to manage this change and uncertainty by acquiring new knowledge (Branson et al., 2002). Forecasting studies, however, are complex and, of course, not consistently accurate in depicting the future. They can only try to predict future developments as best as possible (Saritas and Oner,

2004). The basic idea of forecasting as a tool for long-term planning (Courtney et al., 1997) is to guide decision-makers in specific directions within political, economic, socio-cultural, and technological developments and to support them in times of high uncertainty (Powell, 1992). At the same time, forecasting methods should facilitate discussion between decision-makers and current experts to understand better the paths and possible futures that result from technological development and population aging in the field of healthcare.

The questions were sent via the 1Ka platform. Thus, the concrete Delphi study will be based on the statistical processing of collected opinions obtained from employees in healthcare organizations who perform various tasks related to healthcare and are employed at different organizational levels.

The experts answered the questionnaire in two rounds. The goal of conducting two rounds was that the second round would allow for more unified positions. In this case, a study is appropriate because it is based on the search for consensus. Participating experts could independently express their views and give their ideas and proposals. With the help of a questionnaire, in the first round, we obtained the views and opinions of employees in healthcare organizations about the level of agility, the importance of agility, the need and possibility of changing organizations to agile, and the importance of organizational culture in this regard. After the first round of surveying, we analyzed all the data obtained and sent them with a questionnaire to the respondents in the second round. In the second round, the respondents were asked to check the results of the first survey and judge them again. Thus, in the second round, we tried to influence the respondents to unify their answers as best as possible, following the results of the first round.

2.1.1 Sample

15 employees in Slovenian healthcare organizations took part in the survey. Thirteen of them were female, and two were male. Of these, seven were between 35 and 45 years old, four people were between 46 and 55 years old, and four people were between 56 and 60 years old.

The average age of women was 45 years and of men 48 years. The educational structure of the employees was as follows: 1. Bologna level - 7 respondents; 2nd Bologna level – 5 respondents and 3rd Bologna level – 3 respondents.

The structure of the respondents according to their position in the healthcare organization is presented in Table 1.

Table 1 Respondents' workplace

Workplace	Frequency	Percentage	Cumulative
Head of the unit	1	7	7
BA in health care - work with emergency patients at the secondary level of health care	2	13	20
Medical doctor	2	13	33
Administration in a healthcare facility	1	7	40
Work coordinator	2	13	53
BA in health care - in the intensive care unit	1	7	60
BA in health care – specialistic ambulatory	4	27	87
BA in health care - work in the field of endoscopy	2	13	100
Total	15	100	

Table 2 shows the organizational forms in which the respondents are employed.

Table 2 The structure of the organizations in which the respondents are employed

Organizational form	Frequency	Percentage	Cumulative
Hospital	6	40	40
Private health ambulatory with concession	2	13	53
A private medical institution with a concession	7	47	100
	15	100	

3 Results

The first scenarios were related to organizational culture agility. The results show that a maximum of 40% of respondents think that it is necessary to introduce processes in their organizations in the next five years that will stimulate organizational changes and learning (acquiring new knowledge). The standard practice must become the managerial acceptance of employee mistakes. Consequently, these changes must lead to greater trust in employees. 27 percent of those polled believe that by 2027 in their organization, it will be necessary to ensure that the importance of the dynamics of development focuses on a growth mindset, using failure for innovation and strengthening resilience. Due to the increasing digitalization of work processes, it will be necessary to focus on the perception of technology in the direction of enabling the increase of human abilities, but not its replacement. It will also be necessary to increase the appreciation of empathy itself. 20 percent of respondents believe that by 2027, it will be necessary for the organization to ensure that the presence of elements of organizational culture, such as fear and lack of communication, which hinder

agility, will be rare, minimal, if not even zero. Management must therefore take care to reduce control over employees and increase their availability and level of cooperation and communication. At least 13 percent of respondents think that in the next five years, it will be necessary to decentralize decision-making in the organization. Respondents believe that making partial decisions should be left (within their professional competence) to agile teams. While the respondents reached a unanimous consensus that in their organizations until 2027, it is not necessary to bring decision-making processes as close as possible to employees and thus increase cooperation between employees.

In the context of the second scenario, we assumed that by 2027 there will come changes in organizational culture competencies. Only these will lead to organisational changes that are important for the growth of the organization and the satisfaction of both employees and customers. 67 percent of the respondents believed that by 2027 organisational processes will have to be transformed. Processes will have to be transformed into easier, less detailed ones and may vary within the organization depending on the context the organization will face. Organizational values will have to become: transparency, learning, openness, teamwork, improvement, ownership, responsibility, self-reflection, and self-leadership and empowerment. 20 percent of respondents believe that by 2027, the development of an agile culture will need to bring a greater focus on people in their organization – which includes customers, stakeholders, and the people who deliver the services. Thus, the importance of creating added value for all stakeholders will come to the fore. Only 13% of respondents think that by 2027 they will have regular or frequent and transparent communication in the organization become a normal phenomenon. In the next five, it will also be necessary to ensure that organizational processes are based on trust with minimal (if any) control and minimal bureaucracy. Measures will thus have to be based on results and not on methods. It will be necessary to establish risk tolerance in the organization. The importance and attitude towards learning and continuous improvement of work processes will also have to increase. None of the respondents believes that by 2027 it is necessary to ensure that organizational goals are expressed as relative and dynamic – the shorter the period, the more variable they will be. This would allow objectives and key results to replace performance indicators. Likewise, no one expressed the need to transform the role of personnel and management in the organization. The roles of personnel and management should go in the direction of coaching. The role of managers should more closely resemble the role of a trainer of agile employees.

In the context of the third scenario, we assumed that by 2027 there will be an increase in employees' willingness to change. Increased readiness will enable organizational changes to occur, which are essential for the growth of the organization and the satisfaction of both employees and customers. All three assumptions received the same number of, i.e., 33% of respondents' suggestions. Thus, the respondents believe that there should be organizational changes in their organizations in the following years as a result of the complexity and variability of the healthcare situation. As well as that by 2027 their organizations will be able to implement the changes necessary to transform into an agile organizations. Thus, the characteristics of an agile organization, such as maintaining solid teams and the breakdown of work, and the transfer of work to teams, will also apply to my organization. And that by 2027 it will be possible to introduce organizational changes and change the organization to an agile one in the following cases: By increasing people's abilities and helping management to change its thinking and the nature of practices paradigmatically. Management must move from management processes that include planning, directing, telling, and coordinating to management that focuses on creating the conditions and establishing bases of practice with which employees can develop skills and competencies within their framework and in a mutual partnership. important to the vision and goals of the organization.

In the context of the fourth scenario, we assumed that by 2027 steps will be taken that will lead to agility in the organization. The establishment and execution of steps will lead to the emergence of agility, which will enable the further growth of the organization and affect the increase in satisfaction of both employees and customers. At most, 47% of respondents believe that by 2027, their organization will transition to agile only if the very top of the organization accepts agility as its goal, and the management team will thus work in a more agile way. The management must stop interfering too often in the work of the departments because by doing so, they can cause a departmental war. All managers at all organizational levels must communicate and work following the commitment to the strategic direction of the organization. 33% of respondents believe that by 2027 the organization will transition to agile, provided that agile transformation will mean not only technological development and adaptation of employees to new technological work guidelines but also the transformation of the importance of employees, who must be defined as human capital (social capital) of the organization in which it is necessary to invest. This will increase efficiency and profitability. As can be seen from the analyzed results, 20% of the respondents

believe that the organization will become agile by 2027 if the management of the organization commits itself to the processes of agile transformation and insists on the implementation of the processes. The results are visible in actual actions. Management will also have to focus more on creating new skill sets for employees. However, none of the respondents predicted that by 2027 their organization would transition to agile if it focused on improving overall results rather than specifically on agile techniques.

In the context of the last, i.e., the fifth scenario, we assumed that by 2027 there will be the implementation of measurements (performance) and evaluation of the implementation of steps that will lead to agility in the organization. Measurements and evaluations will help to increase the organization's growth and make it possible to adopt further organizational changes and adjustments based on the criteria and evaluations of the satisfaction attitudes of both employees and customers, which will make it possible to increase the satisfaction of both employees and customers. Based on the analysis of the results, it can be seen that 40% of respondents believed that by 2027 they will implement the following evaluation criteria in their organization: 1. Indirect cultural indicators based on the survey analysis, including teamwork culture, improvement culture, culture imperatives, a culture of vision and a culture of focus. 2. Analysis metrics include process efficiency (e.g., value-added effort as a proportion of total time). 3. Direct quantitative metrics such as period distribution, replenishment frequency, and release frequency. Likewise, 40% of respondents believed that by 2027 customer satisfaction should become a key criterion in their organization. Satisfaction must also be reflected in their opinions and willingness to return. Another criterion will be employee satisfaction. The third criterion will include an approach to innovative solutions and the introduction of modern technologies. At least 20% of the respondents believed that by 2027 in their organization, if they want to become agile, it will be necessary to ensure a distinction between what "is" measured and what "should" be measured.

4 Discussion and Conclusions

As part of the study, a Delphi study was conducted among employees in Slovenian healthcare organizations. The goal of this was to enable the acquisition of views and opinions of the respondents based on the questionnaire, which will lead to an answer to the research question, what kind of organizational changes need to be implemented in Slovenian healthcare organizations, to enable the development of the foundations for the creation of an organizational culture that

will enable the emergence of organizational agility in Slovenian healthcare organizations in the future?

However, what needs to be mentioned first, and what this study also shows, is the paradox of Slovenian healthcare organizations, which can be seen in the chaotic state, poor organization, lack of knowledge about management processes and the fundaments of management, mobbing, burnout of medical staff, increasing staff shortages, waiting for lines, etc. (Fortuna, 2017; Night, 2021). According to Fortuna 2017, Slovenian healthcare is in crisis due to poor management. This leadership crisis results from political staffing and the lack of highly educated personnel in managing healthcare organizations at reputable global universities. Slovenian health care has thus fallen into clientelism, nepotism, and corruption. The commitment to conduct business under international standards for ensuring safe and high-quality medical care, such as the international standard for hospitals AACI and ISO standard 9001:2015, does not help to solve the situation.

The results of our study, which was carried out both in public healthcare and in private healthcare organizations, show that in healthcare organizations, it is not possible to talk about agile processes at this moment, and even less that healthcare organizations are agile. The employees also do not think that healthcare organizations can be defined as attractive to a work environment oriented towards sustainable development at a given moment.

The study results, based on a scenario that should be introduced in Slovenian healthcare organizations in the next five years, show the actual state of Slovenian healthcare organizations in 2022. The results highlight all the shortcomings in the organizations, which, according to the respondents, stem from the management of organizations. Thus, in the framework of the open question, where the respondents were asked to give their views on the processes of agility in their organization, only they gave different opinions. Thus, most individuals find that agility processes are only minimally present in their organization, or that they are still in their infancy, and employees perceive them only in individual moments. The respondents emphasize that it would be necessary to educate the management about agility, and only then would it be possible to hope for fleeting changes. In their opinion, agility processes are necessary for the appropriate development of process implementation because of ever-increasing requirements - digitization, higher quality of work, etc. Respondents further state that their organizations try to be innovative and flexible, but not enough. Although this area is changing slowly with the introduction of new technology, no

investment is being made in educating personnel who could use it. According to the respondents, management should detail how they plan to implement changes regarding agility processes in their organization.

The critical weaknesses of the current management of healthcare organizations are also shown by the fact that as many as 67 percent of the respondents believe that their organizations will have to transform organizational processes in the next five years. The processes must thus become more accessible and more straightforward, not so detailed, and it will be possible to differentiate them according to the context the organization will face at a given moment. It is also evident that, at the moment, the values of healthcare organizations are not based on learning, openness, teamwork, responsibility, and self-reflection; the management and empowerment of employees are also lacking. The ownership of health organizations is also open because a certain degree of privatization of state institutions is also open. This should be based on the co-ownership of employees and not only on health insurance companies. This would solve the complex problem of poor management and thus enable a faster adaptation of the health system to the requirements of solving internal and external organizational challenges (Fortuna, 2017).

The results of the study show that Slovenian healthcare organizations are not agile. This is also indicated by the fact that none of the respondents expressed the need for their organization to move to agile by focusing on improving overall results and not specifically on agile techniques. Indeed, we perceive the need to introduce agile techniques and processes. This can only be introduced through changes in the organizational culture, which must ensure that employees become aware of the importance of agile processes and acquire appropriate competencies that will enable organizational changes and adjustments that will lead to agility in the organization. Here, it is necessary to emphasize that the management of organizations will first have to acquire appropriate skills in the field of agility and then enable employees to acquire the skills necessary for implementing agile processes as part of lifelong learning. This is indicated by the views expressed in the context of the respondents' open questions about the agility of their organization. As part of the analysis of the results of the survey itself, it can be seen that:

- There is a need to promote organizational change and organizational learning in healthcare organizations. It is necessary to ensure that accepting employee mistakes and offering help to employees becomes standard practice. However, we must also emphasize that in healthcare

organizations, it is necessary to ensure the greater trust of the management towards the employees.

- Digitization of work processes requires the management to perceive technologies as a tool that will increase human abilities, not their replacement.
- That empathy is not sufficiently valued in healthcare organizations, which will need to be changed.
- Top management must embrace agility as their goal. It is necessary to stop too frequent interference in the work of departments. All managers at all organizational levels must perform interpersonal communication and work following the commitment to the strategic orientation of the organization.

Within the framework of the study, we thus addressed the issue of agility in Slovenian healthcare organizations and, at the same time, answered the research question, which represents the fundamental goal of the master's thesis. In the end, we must emphasize that it will be necessary to assign a more significant role to agility in Slovenian healthcare, both in the context of scientific research work and in the field of management, the course of operational management processes, the development of human resources and the very attitude of work within healthcare organizations. the last years, the economic and management literature has primarily stressed the importance of knowledge assets for company's competitiveness. Grounded in the knowledge-based view of the firm, which interprets the NPD as a cognitive process characterized by the use, development, and management of knowledge assets, this paper, utilizing a multi-case studies analysis, stresses the importance of considering knowledge assets as value drivers that can support NPD process performance improvements.

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Comparative Analysis of BEM (Building Energy Modelling) Tools and Adequate Management of Complementary, Innovative, and Emerging Technologies for the Nebraska System

Fabiola Colmenero Fonseca*

Institute of Materials Technology
Polytechnic University of Valencia
Camino de Vera s/n 46022, Valencia, Spain

Juan Francisco Palomino Bernal

Technological Institute of Ciudad Guzmán
Department of Earth Sciences
Avenida Tecnológico 100 Ciudad Guzmán de, 49100, Cd Guzmán
Jalisco, Mexico

Ramiro Rodríguez Pérez

Technological Institute of Ciudad Guzmán
Department of Earth Sciences
Avenida Tecnológico 100 Ciudad Guzmán de, 49100, Cd Guzmán
Jalisco, Mexico

José Ramón Albiol Ibanez

School of Building Engineering
Polytechnic University of Valencia
Camino de Vera s/n 46022, Valencia, Spain

** Corresponding author*

Abstract

This article discusses the growing popularity of software that simulates the energy consumption of buildings, Energy Plus, Insight, Green Building, and Revit. These programs allow you to model and analyze different scenarios to optimize the energy efficiency of a building. The use of biomaterials, such as straw and raw earth, is also gaining traction as a sustainable alternative to modern building materials. The Nebraska-type building system is a self-supporting structural design that uses interlocking blocks of straw bales and wood to reduce materials and energy consumption. The article presents a case study in Querétaro, Mexico, demonstrating the benefits of using bioconstruction with the Nebraska

system. With Revit, a simulation is developed as an analysis-diagnosis using the complement of Energy Plus, Insight, and Green Building. The qualitative and quantitative method is used to contrast the results with the support of the Energy Modeling of Buildings (BIM) program. The double consumption of resources is evident if it is done with traditional materials such as brick and concrete, being less economical, which also means a more significant impact on the environment from its manufacture abortion to annual energy consumption. Bioconstruction consumes 10,670 KWh per year, and conventional construction 24,417 KWh. The results for the simulation were as follows: a) The maximum value of the cooling load was 12,064 W in bioconstruction and 13,479 W in the building with conventional materials b) Maximum value of the heating load for the simulation of bio construction was 11,351 W of consumption was obtained and for conventional construction a consumption of 12,429 W when using the Software described. SolidWorks and the simulation corresponding to thermal analysis are also used to analyze the heat convection of the primary materials used, consolidating the reliability of Bioconstructions. The simulations showed that bioconstruction provides greater thermal comfort than conventional materials. It is concluded that a bioconstruction is an eco-sustainable option that reduces the direct impact on the environment and can be implemented in multiple construction systems based on straw and bamboo for sustainable buildings with low economic cost.

Keywords –Building Energy Modelling, Nebraska System, biomaterials, planning, and management, sustainable buildings

Nature of proposed paper: Practical Paper and Academic Research Paper

1 Introduction

In recent years, constructions repave represented advances in the area of sustainability. However, their acceptance could be more convincing. This article presents a case study in Querétaro, Mexico using the Nebraska-type building system compared to emerging energy consumption technologies that use the software as monitoring. The Nebraska-type system combines wood and straw to build ecological and sustainable houses, where wood is the prim material straw structures were made of bales by hand de t the strength and flexibility of their intrinsic fibers, which were gradually used in construction from and easy-to-handle packaging that was later industrialized. Its constructive origin is due to the European immigration of the Missouri River that was in a land lacking construction material, such as trees and stone, which abounded in their countries of origin; even the availability of mud for adobe was complicated since they did not have fuel to cook them (Kahn, 1979). It was after the westward expansion due to regulation requiring the construction of permanent housing for land acquisition that the peat clod technique was developed (Kahn, 1979).

This technique was first used in 1846 when Mormons arrived in Nebraska. Peat block construction is based on extracting brick-shaped earth blocks from swampy areas, which are then used to build walls (Kahn, 1979). The result of these buildings is the Nebraska style—a—arc—an atruestylea true stylized by self-sufficiency, used from 1915 to 1940. At the same time, in Europe, thatched roof buildings began in the 20th century and ended at the same time (Nitzkin, 2021). It is believed that the building system came to Europe from Canada first to France, then spread to England, and was used to reconstruct areas after World War I. System o It is still used today with a system of wooden posts and beams, filled with straw and inexpensive means, 2010ItItt is an accessible process that makes it ideal for a self-construction process available to everyone without needing much-bowled knowledge).

In Mexico, buildings form a relationship with context. The physical expression and structure of nature native to Mexico are related to natural resources. The construction methods used throughout the house seemed to result from ancient oral or practical experience passed down from generation to generation. Today the use of emerging technologies through software is a reality compared to simulations of the energy consumption of buildings. Energy Plus, insight, and Revit are complementary and innovative technologies and fundamental tools for planning and managing woncerconcernannual energy consumption in buildings.

An alternative material thermal and acoustic insulator, which works as a moisture regulator. Within the construction, it is a material that adheres easily with clay and lime and has a low economic cost and a low environmental impact.



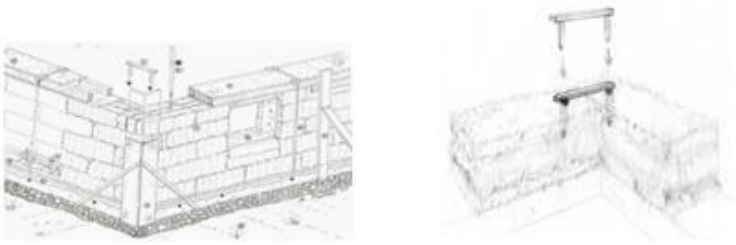
Figure 1. Simonton House, Nebraska 1908. Source: construccionbalasdepajauax1

[1] *Simonton House, Nebras 1908. In: Construction with straw bales [web] Spain: Marta Revuelta, 2015 [Accessed 12 May 2016] Available in: https://construccionbalasdepajauax.files.wordpress.com/2015/02/simonton-house-nebraska-1908.jpg?w=676 in https://construccionbalasdepajauax.wordpress.com/2015/07/07/un-poco-de-historia/*

The current green building in the US is not simply a phenomenon. At the beginning of the twenty-first century, it was a movement that represented a set of non-industrialized construction technologies mainly used for residential uses. (Carro Castro, F. 2007)

2 Materials

For the manufacture of straw bales for the construction of houses (See fig. 2a and fig. 2b), wheat, spelled, rice, and rye straw are mainly recommended. The straw bales are made in various formats: the smallest have measures ranging from 32cm to 35cm x 50cm x 50 to 120 cm, although the width of 50 cm can be somewhat smaller. In production, balers develop a pressure of between 80 and 120 kg / m3; Bales made with lower pressures are unsuitable for construction. Large bales, 70 cm x 120 cm x 100 cm at 300 cm or even more significantly, are more significant for the signification of load-bearing walls since they generate larger wall widths and, because of their greater weight, can only be moved with forklifts. The baling pressure ranges from 180 to 200 kg/m3. (Rivero Nogueiras, V., 2016)



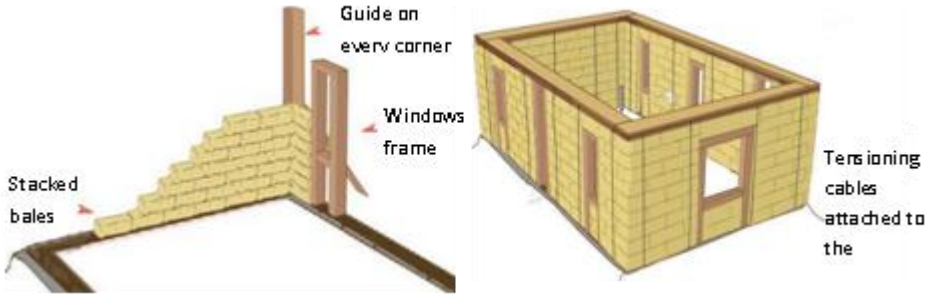
2a. *2b.*

Figure 2. a) Nebraska Wall – Maren Termens from the book Straw Houses. b) Drawing of corner staple – Maren Termens from the book Straw Houses. Source: Romans Torres (2014)

2.1 Structural walls

In load-bearing walls, straw bales directly support the roof's weight without any other structural support, such as wooden poles or cement columns. (See Figure 3a). To make the baled walls form a continuous connection between the foundation and the roof plate, tensioners arise from the foundation, pass through

the pass raw bales, and end up tied to the roof structure. That is why this tensor must be firmly attached to the foundation. When tensioners are not used, the viable option is to occupy smooth construction iron rods of 6 or 8 mm. in diameter and 15 cm. (see Figure 3b) (Rodríguez Vivanco, C. 2007)



3a. *3b.*

Figure 3. a) Stacking of bales, b) Tensile cables attached to the Foundation. Source: Construction with Bales an Alternative for the Araucanía Region. Author: Rodríguez Vivanco, C. 2007

2.2 Eco-innovation for Today in the Reality of Latin America and Europe

The material we study, packed straw, plays a fundamental role in energy efficiency. Its characteristics make it advisable to place it in areas where you want to limit heat losses, especially in the facades facing north (in the northern hemisphere). In these facades, glazed surfaces should be avoided or limited as much as possible since they represent an area of low gain but outstanding excellence. On the other hand, in the south, you can use larger glazed surfaces or even enclosures with other features such as heat accumulation. (Carro Castro, J., 2006)

The confrontation tradition/modernity is universal and is reflected in the change of the roofs of the houses. According to A. González (2001) "*The traditional, the pre-industrial past is considered before the arrival of capitalist material culture as a symbol of opprobrium that must be denied.*"

3 Methodology

For this case study, energy efficiency is measured in four phases. The first three are empirical, and the fourth is theoretical-practical. The first phase: Starts with brick walls and straw walls, which are planted on a stone base, and joined with

clay mortar, lime, and sand, to later stack them together and give the function of the load-bearing wall with a thickness of 0.50 meters. In the second phase: it is used as a coating gypsum made with raw earth, clay, water, and organic waste. In the third phase: A bamboo structure based on the geometry of a dodecagon is used to distribute the loads towards the load-bearing walls made of straw, unifying the bamboo sections; Potential problems related to water runoff and natural lighting are also resolved. In its last phase, a simulation is developed as an analysis-diagnosis through the complement of Energy Plus, Insight, and Green Building, with Revit, where the qualitative and quantitative method is used.

3.1 Modeling and Configurations in Software

It is essential to configure the modeling and configuration of materials for Revit software such as SolidWorks, yielding data for analysis and digital interpretation in fava good contains preconfigured materials, facilitating and streamlining the development of any modeling. SolidWorks lacks preconfigured sustainable materials; however, it has a section benefiting from the development simulation regarding the convection of the heat flow of the materials used.

Revit and SolidWorks were used for this case study, modeling two buildings simultaneously with different materials; the first model was with a conventional system and materials in Mexico, such as brick and a concrete slab. The second model uses the Nebraska-type system based on straw bales and bamboo.

Regarding the SolidWorks Software and the directed orientation, the same methodology will be used for modeling as Revit; the only difference will be the orientation of the study, focusing on the efficiency of heat convection in both construction systems covering the roofs of the models with bamboo and a concrete slab, concerning walls the models will be simulated one with solid brick and the other model with straw bales again using Revit. The forum software above buildings simulates the materials that make up each construction system to be studied to obtain an analysis of the energy consumption of the building. Figure 4 shows the methodology developed to elaborate from the modeling in three dimensions, its configurations, and parameterizations to reach the results of the simulations using the different software, complements, and plugins to obtain desired results.

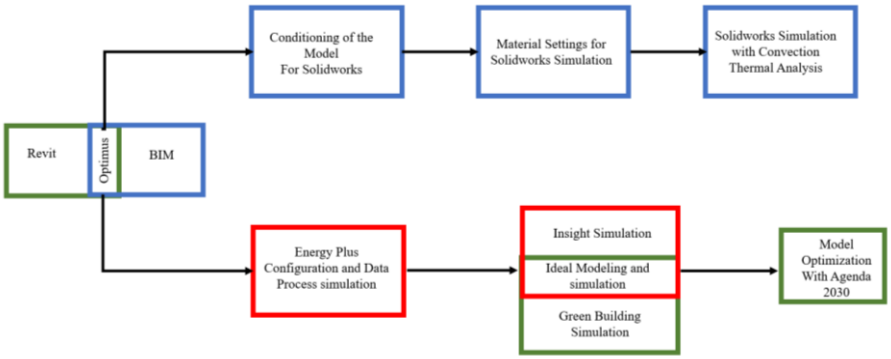


Figure 3. Methodology for modeling and simulation processes. Source: Authors.

3.1.1 Revit and BIM

For the modeling of any building and to carry it out properly, it is necessary to analyze the project, know the material and construction systems, and make their configuration in the software, obtaining an ideal modeling configured entirely with BIM. For this article, a building was modeled in duplicate, one model using Biomaterials and another using construction materials for conventional use in Mexico. Some materials were found preconfigured in the factory software, and others were configured manually, above, due to their non-existence in the software and the need to complete the BIM modeling of both mod; Figure 4, the "bamboo" material is shown, configured in Revit. In what corresponds to the constructive materials of conventional use in Mexico, the software has all the required materials preconfigured, streamlining the workflow for this type of boatbuilding its BIM modeling in Revit, in Fig. 5, the material "Brick", pre-established in Revit, is shown. Figure 4 shows the "bamboo" material, edited manually in Revit.

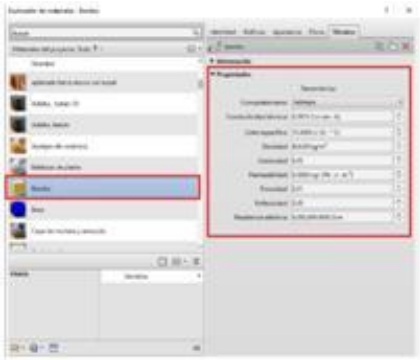


Figure 4 Bamboo Configuration

Table 1 shows the structure of both models to be developed and organizes them correctly according to each construction system.

Table 1 Materials and Process to both Models

Building area	**Conventional system**	**Nebraska-like system**
Foundation	Stone masonry foundation fathoms to 80 cm depth glued with mixture Cem. Arena Prop 1:4:5	Fathom stone masonry foundation 80 cm deep glued with lime-sand mortar prop 1:3
Walls	Capuchin wall of annealed red partition 30 cm thick, glued with mixture cem-cal-sand prop 1:3:5	Straw bale 45 x 60 x 90
floors	Jalcreto firm, jal-sand-lime prop 1:5:6, cement leveling paste sand ceramic floor, glued with gray adhesive.	Floor system opus signum based on earth and ceramic pieces and sealed with linseed oil.
Covers	Reinforced concrete slab and lock 12 cm thick, finished with shade brick and waterproofing top 10 Comex.	She is armed with a bamboo structure with a crushed bambosheetset, polyurethane foam as insulation, natural wax, and linseed oil to waterproof the cover.
windows	1st pine wood frame and 6 mm tinted glass, shaft, and structural wood girder.	1st pine wood frame and 6 mm tinted glass, shaft, and structural wood girder.
Doors	Shaft and girder of structural wood, wooden frame, and wooden stave.	Shaft and girder of structural wood, wooden frame, and wooden stave.
Initial coating (walls)	Flattened based on cement mortar sand, prop 1:4	Flattened earth base with long straw and horse or cow manure.
Final coating (walls)	Multiple kinds of pasta from Cemex finished stucco.	Pasta based on sifted earth, quicklime, and cactus slime with natural dyes.

Source: Own elaboration

3.1.2 SolidWorks and Sustainable Materials

The SolidWorks software is software designed for the modeling of parts for physical/mechanical analysis in the present study, the same building developed in Revit was modeled in duplicate for the thermal analysis of heat convection through a heat power induced at one end of the materials, simulating the model with the materials of the traditional type system, as well as the biomaterials of the model in Nebraska type system. The software does not have a wide range preconfigured to use and simulate like Revit software. Figure 5 shows the selection of the type of study and configuration of materials in SolidWorks concerning their physical/mechanical properties.

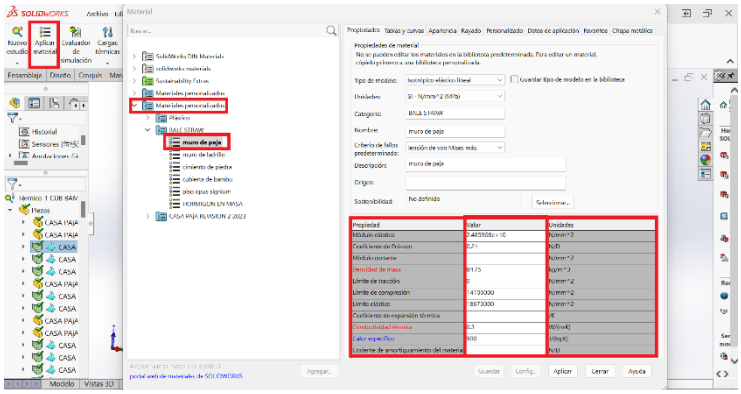


Figure 5 Configuration of Materials in Solids Works.

Regarding the properties of Elastic Modulus, Shear Modulus, Mass Density, Compression Limit, Elastic Limit, and Thermal Conductivity of Bamboo, the results of Martínez García (2015) were used. Also, Viera et al.'s (2020) results were used for the simulation, comprising the Elastic Modulus, Poisson Coefficient, Mass Density, Compression Limit, and Elastic Limit. The properties that were used for the simulations of the annealed red brick were; Elastic Module, Shear Module, Mass Density, Compression Limit, Thermal Conductivity, and Specific Heat products obtained by Sánchez-Tizapa et al. (2013), and for the mass concrete, the simulation was developed with the Mass Density, Thermal Conductivity and Specific Heat published in the CONTART 2016 ("Thermal and Acoustic Properties in Walls and Projected Earth Coatings and their Compliance in the CTE", 2016).

3.2 Parameters and Simulation of Models with Software

In order to perform any simulation, regardless of the software to be used, the different methodologies developed to obtain the results to be needed must be understood; the above depends on each software, its needs, and requirements. Revit and Solidworks use different methodologies for their configuration, parameterization, and production of results, which range from the use of weather stations and their information, as well to mathematical models and advanced mathematics such as the finite element method, each software, and its development is described below.

3.2.1 Revit and Energy Plus

When modeling and configuring materials in Revit (BIM), it is possible to use the Energy Plus add-on to create the different "zones" to be analyzed energetically and concerning the square meters of the building without taking

into account the users who would use the spaces or "zones" previously defined, as shown in Figure 6. This is essential for the production of data and information regarding the model and its volumes to later use the Insight or Green Building plugins. Once the above is done, it is imporessentialelect a weather station, preferably the closest to the study area,s o that Revit and the associated servers can perform the corresponding analysis; Figure 7 shows the weather station used for this work.

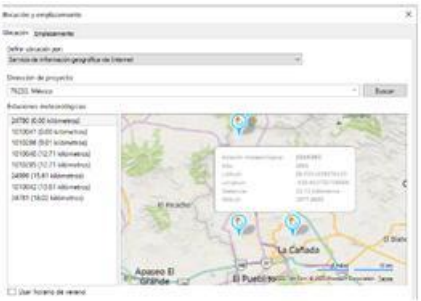


Figure 6 Selection of Weather Station for the Simulation

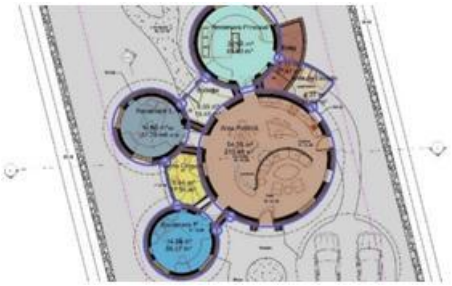


Figure 7 Classification of "Analysis Zones in Revit"

3.2.2 Simulation with Insight and Green Building

Having the tabulators of spaces, energy zones, and consumption generated by Energy Plus with the Revit BIM model develops the simulation of Insight and Green Building to obtain energy consumption considering the spaces and energy "zones" occupied by inhabitants; the above is shown graphically in Figure 8. Insight performs analysis templating the energy costs of the building concerning materials, orientations, type of windows, and sun and hand as the comparison between the energy models analyzed or previously modeled. According to Insight for Revit, the 9th section shows the recommended suggestions for making the building more efficient.



Figure 8 Analysis areas designated for calculation1

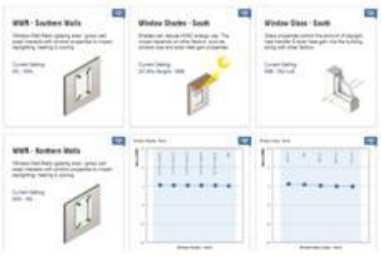


Figure 9 Software recommendations for improving model performance

3.3 Simulation of Thermal Analysis in Solid Works

Having the model made, the materials configured and saved in SolidWorks, the simulation corresponding to "Thermal Analysis" is configured, and the configuration of the necessary parameters for it is carried out, these being those shown in Fig. 10

Materials are only assigned to elements that theoretically have that component; then, the model is taken as a fixed union by the type of model to be simulated. The parameters of "loads" are assigned these the heat output on the inner surface of the material and the outside as convection in order to simulate the heat convection efficiency of the materials, performingfour4 simulations in total concerning two different systems and construction materials, the first; A construction with traditional materials, using the concrete slab cover and solid brick walls 0.50 cm. thick, to obtain the convection data of the material. The second, with the same model but with biomaterials, simulated the cover covered bamboo and the walls with a Nebraska straw wall of .50 cm thick. The configuration for all simulations follows the same order described above, shown in Figure 11 and enclosed in red; only the parameters of the materials for convection analysis change busing heat load shown in tTable2 to obtain results.

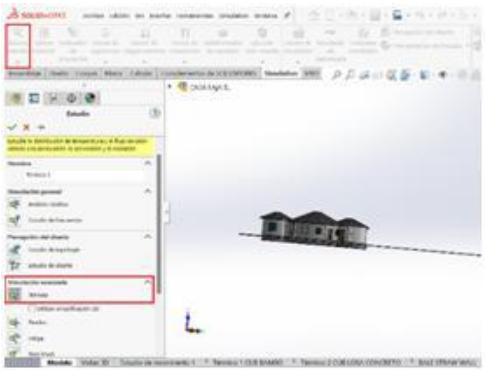


Figure 10 Analysis Type Selection in Solid works

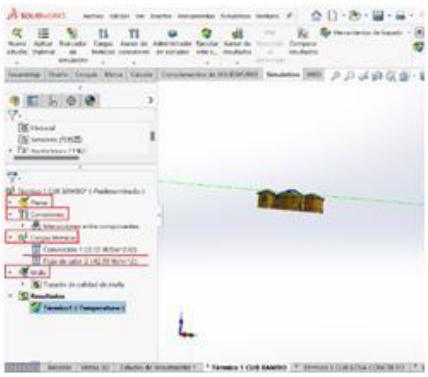


Figure 10 Configuration of simulation by Convection

The differences in the configurations only cover the parameters of the materials for convection analysis using a heat load shown in Table 2 for obtaining results and a simulation time of 5 seconds with the preset heat flow for 5 seconds and sampling every .5 seconds, respectively.

Table 2. Data to insert for simulation of convection analysis in traditional materials and biomaterials

Rooftop Material Simulations			
Parameters Simulation for Bamboo Cover		Parameters Simulation for Concrete Slab Roof	
Heat Flow in Interior Wall	**Convection Coefficient**	**Heat Flow in Interior Wall**	**Convection Coefficient**
42.99 W/m^2	0.12 W/m^2·°K	42.99 W/m^2	2.3 W/m^2·°K
	Room temperature in Muro Exterior		**Room temperature in Muro Exterior**
	289.15 °K		289.15 °K
Simulations of Materials in Walls			
Simulation Parameters for Straw Wall		**Simulation Parameters for Brick Wall**	
Heat Flow in Interior Wall	**Convection Coefficient**	**Heat Flow in Interior Wall**	**Convection Coefficient**
42.99 W/m^2	0.3 W/m^2·°K	42.99 W/m^2	1.04 W/m^2·°K
	Room temperature in Muro Exterior		**Room temperature in Muro Exterior**
	289.15 °K		289.15 °K

Source: Authors.

4 Discussion and Results

4.1 Revit and Energy Plus

Once the energy simulation and analysis have been carried out, Energy Plus and Revit produce several results, among which the energy load stands out, showing the quantities in a unit of Watt necessary to cool or heat the model, shown in Table 3, in addition to the general energy analysis producing as a result of lower energy consumption the Nebraska type construction system compared to the conventional system according to the simulation executed in the software described above, shown in Table 3.

Table 3 General energy consumption of both model systems.

General Energy Consumption of both Buildings by Energy Plus		
Type	Parameters	Watts
Nebraska ś System	Total maximum refrigeration load value	12,064
	Total maximum heating load value	12,429
Traditional System	Total maximum refrigeration load value	13,479
	Total maximum heating load value	11,351

4.2 Insight and Green Building

Once the Energy Plus analysis is done, it is possible to simulate with Insight which produces the energy cost for the traditional system in dollars per m^2 per year. Also, the simulation provides recommended suggestions based on the analysis of model information for the use of solar energy and natural ventilation to improve the performance and use of natural resources, all based on model information, information from the nearest weather station, and information provided by Energy Plus, this is shown in Figure 11a.



Figure 11a. Insights cost results and optimization suggestions.

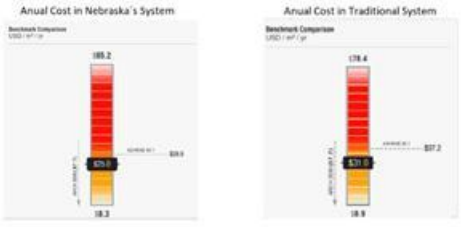


Figure 11b. Comparative analysis of the energy costs of both Systems

Based on all the above, the results of the simulation are produced, and a comparative review of the Nebraska and conventional construction systems Ares made on the costs of using the building in dollars on an annual basis, Figure 11, shows the annual costs of the simulated buildings for a better appreciation of the results produced.

Concerning Green building, it also shows an analysis of actual annual total costs from the analyses produced by Energy Plus, producing through formal tabulators and without the possibility of adopting improvements to the model and its conditions, the annual energy costs of the model, CO2 emissions, life cycle of electrical energy, etc. A comparative analysis of the simulations produced for both modeled systems and their annual costs is carried out. (See Table 4)

Table 4 Overall results and costs of both systems.

Global Results of Green Building Simulation		
Parameters	Nebraska ś System	Traditional System
Energy, Carbon, and Cost Summary	$2,532	$4,634
Annual CO_2 Missions	5.7 mg	7.5 mg
Lifecycle Electric Energy	10,670 KWh	24,417 KWh
Annual Energy	1,763 MJ/m^2/year	2,049 MJ/m^2/year

Green building also quantifies energy costs, building, CO2 emissions, energy life cycle, and energy uses in the building graphically, corresponding to the simulations developed and the information collected; figure 12 shows the information described above graphically for the Nebraska System.

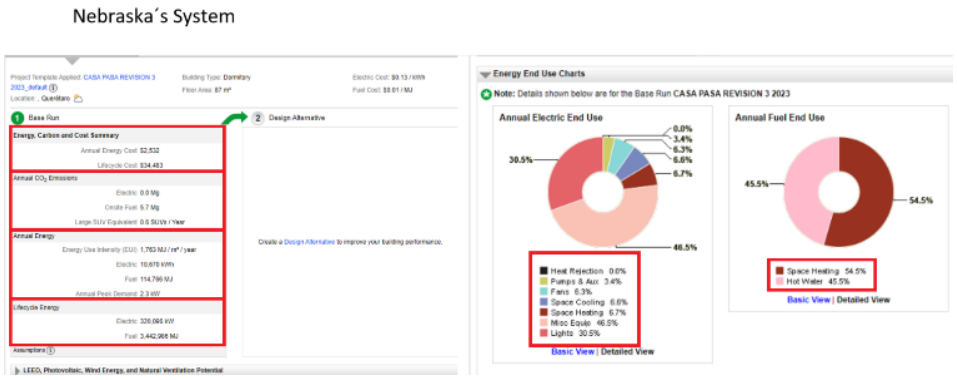


Figure 12 Green Building Energy Cost and Consumption Results for the Nebraska System

It is also possible to appreciate the results obtained for the conventional system graphically, shown in Figure 13.

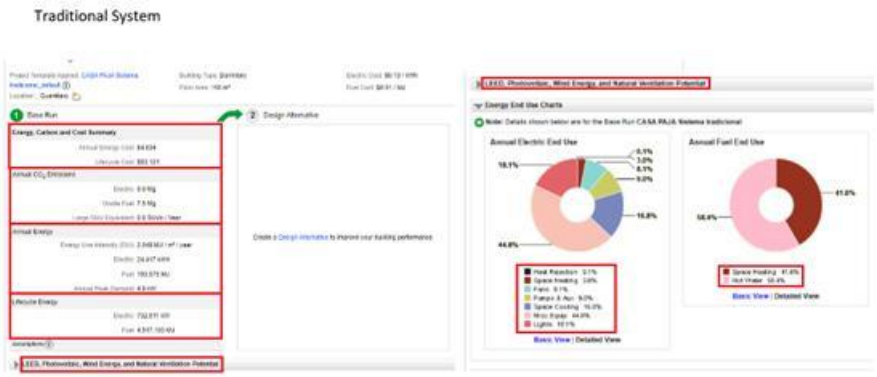


Figure 13 Cost and energy consumption outcomes of green building for the traditional system.

4.3 SolidWorks

The product of the four simulations carried out in SolidWorks is represented by the Software quantitatively and graphically; the simulations configured as heat power are executed in an analysis in time, showing the temperature that the material would arrive under the assumption of constant flow without any logical, physical reaction of the simulated material, obtaining very high or shallow measurements. However, this result does not affect the purposes of this research

due to the interest in analyzing the simulation and specifying the convection properties of the simulated materials, regardless of whether walls or roofs. Figure 14 shows the simulation of the bamboo roof.

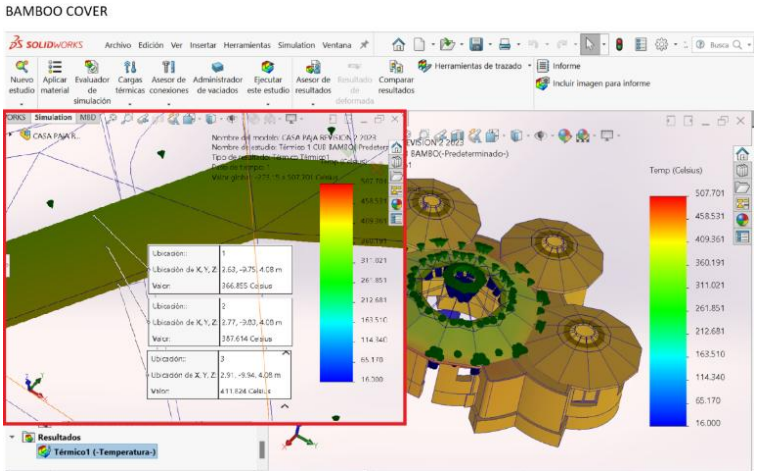


Figure 14 Results of the roof bamboo simulation.

The roof with a concrete slab is shown in Figure 15, representing quantitatively and graphically in color scale the results of the convection analysis in the simulation.

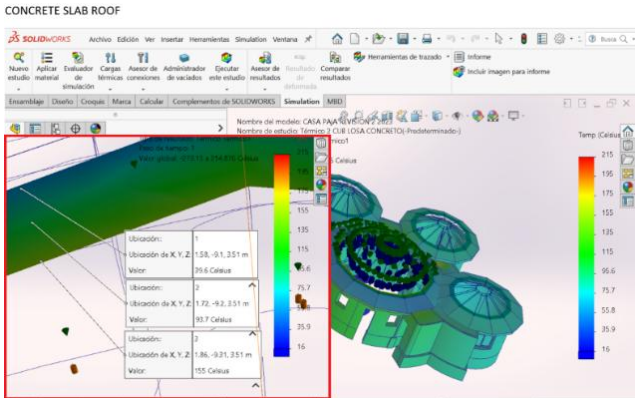


Figure 15 Results of the simulation of the concrete slab roof.

Regarding the simulation of materials in walls for the Nebraska system they are shown in Figure 16.

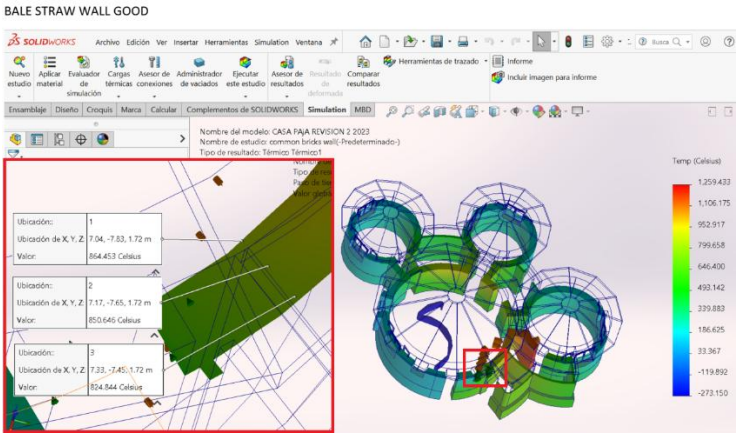


Figure 16 Results of the bale straw wall convection simulation.

Finally, Figure 17 shows the results obtained in the simulation of the conventional system with brick wall and its results of convection analysis.

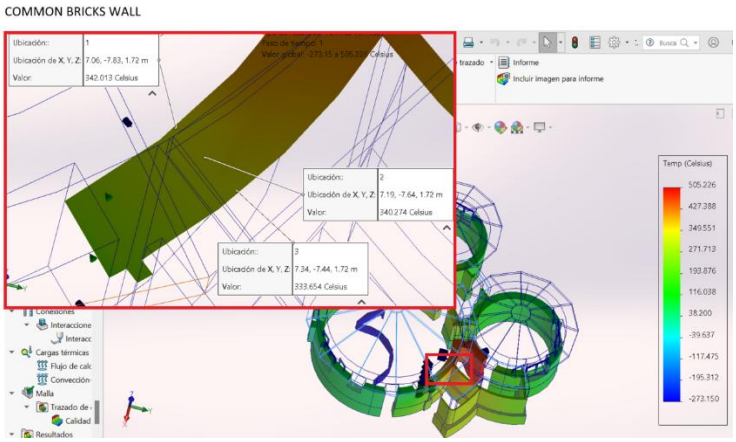


Figure 17 Results of convection simulation of common brick walls.

Table 5 shows the results of all the simulations developed in SolidWorks, enabling the comparative analysis between them and the convection efficiency of the materials proposed in the multisided systems.

Table 5 Overall results and costs of both systems.

SolidWorks measures of convection analysis simulation on materials					
Analysis Section		Material	Measure 1	Measure 2	Measure 3
Walls	Nebraska ś System	Bale Straw	864.453 °C	850.646 °C	824.844 °C
	Traditional System	Common Bricks	342.013 °C	340.274 °C	333.654 °C
Covers	Nebraska ś System	Bamboo Cover	366.855 °C	387.614 °C	411.824 °C
	Traditional System	Concrete Slab Roof	39.6 °C	93.7 °C	155 °C

5 Conclusions

In the present research, it was used and diversified in software and methodologies. Regarding Revit and Energy Plus, they offer the possibility of generating a BIM model and its quantification, making time and resources more efficiently. Insight and Green Building complement the study, based on the data generated between Revit and Energy Plus, theoretically obtaining the energy expenses and costs of the model generated when conditioning the spaces by heating or cooling. Concerning the recommendations of Insight, they are interesting for obtaining better thermal comfort and use of natural lighting and ventilation, reducing the consumption of resources shown in the tabulators and comparisons of this work. Although designed for modeling and simulation of industrialized parts, SolidWorks was functional for the expected result. However, it involved more work time to use it due to the configuration of custom materials; however, when simulating the convection of the materials, high temperatures occurred in both bamboo and straw bales, checking the high heat propagation in the materials for their thermal characteristics, Benefiting the model concerning natural thermal comfort and consequently to the environment, due to the type of material theoretically used.

Acknowledgments

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The Role of Think Tanks in Megatrends Analysis and Future Research

Berthold Kuhn*

Department of Political and Social Sciences
Freie Universität Berlin & InnovateCo Consultants
Ihnestrasse 22, 14195 Berlin

Dimitrios Margellos

ZOE Institute for Future-fit Economies
Norbertstraße 31
50670 Köln

* *Corresponding author*

Abstract

This paper aims to explore the interconnection between megatrends analysis, future research, and the role of think tanks. Think Tanks are presumed to drive megatrends discourses and make significant contributions to future research and strategic foresight. However, relatively little attention has been paid to think tanks explicitly or implicitly working on megatrends and future research. This paper analyses discourses on megatrends and looks at the evolving global landscape of think tanks. It shines a spotlight on seven think tanks from different countries and world regions that apply diverse strategies of knowledge dissemination and policy advice. Policymakers, business leaders, and asset managers have shown a growing interest in megatrends analysis and future research which is leading to increased visibility for some think tanks. Furthermore, the dynamics of international cooperation and geopolitical developments have also contributed to the expansion and growing diversity of the think tank landscape, including in the Global South.

Keywords – megatrends, future research, think tanks, strategic foresight, policy advice.

Paper type – Practical Paper

1 Introduction and methodology

The main objective of this paper is to improve the understanding of the dynamic discussion around megatrends, as well as the essential characteristics of future research. Additionally, the paper seeks to highlight the contributions of think tanks in fostering future literacy and conceptual frameworks addressing major challenges for humanity.

Academic literature that is reflecting on the role and challenges of think tanks is relatively limited. One of the more recent books is an edited volume by James McGann (2021) who has been in charge of the flagship reports of the Global Go To Think Tank Index (GGTTI) of the Think Tank and Civil Society Programme (TTCSP) hosted by the Lauder Institute at the University of Pennsylvania for many years but ending in 2021(TTCSP, 2021). McGann invited leading think tank professionals to reflect on critical issues affecting the work of think tanks. The reflections of some authors of the book are worth quoting to introduce the relevance of the topic and the opportunities and challenges think tanks currently face.

> *"Often, academic work is far away from political realities. It can also be unsuited in its approach if it ignores institutional, legal, and governance constraints. Therefore, think tanks can play a role in translating findings as well as practicing applied research with a more policy-oriented focus that complements more academic work" (Wolff, 2021: 54)*
>
> *"Midway between academia and politics, these centres of thought have transferred rigorous studies to political praxis, both in terms of public discourse and policy. But is this link still valid at times of increased political contestation and of traditional power structures?" (Morillas, 2021: 59)*
>
> *"Think tanks are currently caught in a paradox. From environmental and climate injustice, to extreme inequalities and global pandemics, the world faces an extraordinary set of challenges that think tanks can contribute significantly to addressing. Yet, they must do this at a time when profound disruptions such as rapid technological advances, shifting centres of global power, decreasing levels of trust in experts, democratic disorders, and fake news are providing a myriad of new threats and opportunities that challenge the ways in which they currently operate." (Leach, 2021: 107).*

To begin, section two of this paper explains how megatrends analysis, future research and strategic foresight relate to and complement each other in understanding future developments while also pointing to some features which distinguish them from each other. Section three of this paper discusses the

definition and the evolution of megatrends analysis and future research and explores how megatrends discourses and future research gained traction over the past decades. Section four defines think tanks and comments on the evolution of the global landscape of think tanks. With a purpose to illustrate the work of think tanks related to megatrends and future research in different ways, section five introduces seven diverse think tanks from different countries and world regions which either explicitly or implicitly engage in megatrends analysis and future research.

This paper seeks to fill a gap in academic literature by analysing the evolution of megatrends and future research which has received limited attention. The limited interest of the profession to document and analyse its historical evolution could probably be attributed to an inherent preference of megatrends experts and futurists to looking forward rather than backward.

This paper references landmark publications in think tank analysis, particularly the TTCSP's "Go To Think Tank Report" series (TTCSP 2021), which maintained a global database of over 8,200 organisations from various countries and regions but is currently discontinued. It is referenced by leading media, especially in the United States of America (U.S.) (Chafuen/Forbes, Feb. 15, 2021).

The rankings are based on surveys. The list of almost 4000 voters includes university faculty and administrators, journalists, policymakers, think tank players, and donors. TTCP data set does not include a category for think tanks working explicitly on megatrends or engaging in future research. Furthermore, this paper gathers diverse evidence from various other sources to demonstrate the rising attention paid to megatrends analysis and future research and the growing number and diversity of think tanks in various parts of the world. Evidence includes academic papers, reports, and interviews with experts.[1]

The methodology also includes semi-structured interviews with leaders of various think tanks in different countries and world regions. While it is not a representative sample, attention was paid on criteria of diversity. Interviewed think tanks included organisations from different countries and world regions and organisations of different size and thematic focus. The interviews cover organisations with an explicit focus on megatrends and future research, while we

[11] *We have also made inquiries on the influence of megatrends discourses and think tanks to ChatGPT, an artificial intelligence language model developed by OpenAI (ChatGPT, Version March 14, 2023). We are aware of the ongoing discussion in academia to ban the use and citation of ChatGPT in academic works. We believe that the discussion has not come to an end. While we refrain from quoting our inquiries in the main text of this paper, we would like to draw attention that ChatGPT response are currently biased toward mainstream U.S. American think tanks as ChatGPT collects its artificial knowledge and intelligence from big data analysis and the large majority of openly available reference to think tanks is found in the U.S.*

have also included some others which do not explicitly use such frameworks, but are in fact doing analysis that is relevant to megatrends and future research discourses. Interview partners were also selected on the basis of their expressed interest in participating in the project.

2 Megatrends, future research, and strategic foresight

Megatrends, future research, and strategic foresight are interconnected and can provide a comprehensive understanding of future developments. However, there are also notable differences between them. While megatrends analysis is more explicitly based on factual data, future studies and strategic foresight rely more on methodologies that involve specific expert input and the use of tools like horizon scanning, road mapping, and scenario development.

Megatrends analysis focuses on identifying major trends and forces that will shape the future over the next decade and beyond, including how these trends intersect with one another. This approach aims to provide deep insights into the dynamics of global trends based on the analysis of data, discourses, and agendas of influential political, academic, and business institutions, social forces, and the media. On the other hand, future research is primarily focused on methodological approaches to forecasting, such as horizon scanning, scenario development, backcasting, and predictive modelling. Both address challenges for humanity and aim to create awareness for the relevance of future literacy.

Strategic foresight, meanwhile, is a more proactive approach to preparing organisations, companies, groups, or individuals for change. It involves a structured and systematic process of exploring and creating possible futures, and developing robust strategies and plans that can handle a range of different scenarios. Strategic forecasting is influenced by a variety of tailor-made business approaches of different organisations and companies, which makes it difficult to generalise on its significance for addressing challenges for humanity and promoting the common good.

3 Definition and evolution of megatrends analysis and future research

Global megatrends are trends that strongly influence different spheres of life in many countries and at different levels, covering political, economic, natural environmental, social, and cultural dimensions. They describe large-scale, long-term shifts with wide-reaching effects across different localities and world regions

that attract attention from global leaders in politics, business, academia, media, and social affairs.

In their book "Global perspectives on megatrends" Kuhn and Margellos (2022) applied five criteria to prioritize big trends: (1) level of coverage by research activities, (2) level of political attention, (3) level of interest to global investors and business communities, (4) level of media coverage, and (5) attention paid by social movements. They adopted a comprehensive, global approach to megatrends, including political and social trends, such as rising inequality and migration.[1]

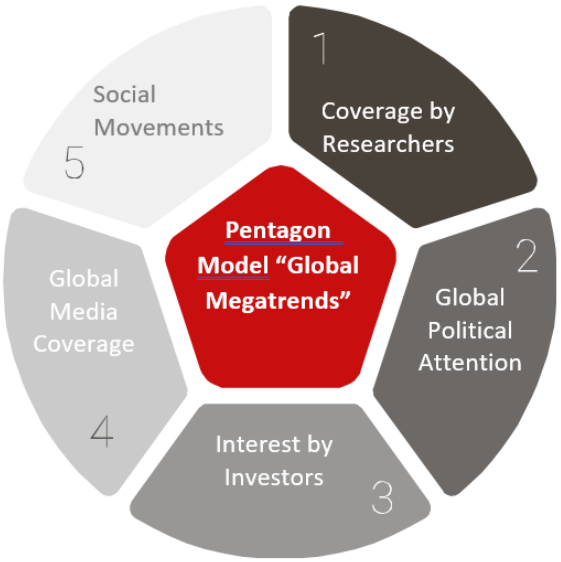

Figure 1: Pentagon Model Global Megatrends (Kuhn & Margellos, 2022).

John Naisbitt was a pioneer of megatrends and future studies. His book "Megatrends: Ten New Directions Transforming Our Lives" was first published in 1982 (Naisbitt, 1982). It focused mainly on the United States but also attempted to present a global outlook. Naisbitt accurately predicted the change from industrialized to information societies. Megatrends was published in 57 countries and sold more than 14 million copies. Subsequently, Naisbit worked for several academic institutions and founded the China Naisbit Institute at Tianjin University in China in 2009.

[1] *The 12 megatrends identified in the book are: climate action and sustainability; digitalization; inequality; demographic trends, urbanization and smart cities; health and nutrition trends; green economy; sustainable finance; multipolar world order and the future of multilateralism; democracy and governance innovations; civilizational developments (diversity, individualization and loneliness, gender shift, and identity politics); and migration (Kuhn & Margellos, 2022).*

Today, a large number of academic institutions, think tanks, researchers and analysts engage in learning, analysing, and forecasting future developments. Asset managers of many big investment fonds show a keen interest in megatrends research. Major consulting firms, including McKinsey, PwC, Deloitte, Roland Berger and many others as well as major think tanks like the World Economic Forum, Bertelsmann Foundation and Brookings conduct rigorous analyses of global risks and trends. Many other non-profit institutes, individual experts, but also international organisations like the International Labour Organisation (ILO) and national-level Ministries engage in future research. Megatrends and future research are also of vital interest for multinational corporations and asset managers. The German car-manufacturer Volkswagen runs a unit staffed with 27 future research experts. The number of academic publications on megatrends and future research has been steadily increasing over the years[1], as has the number of consulting firms and other organizations using foresight and scenario planning. We have also observed a growing interest in future-focused events and a rising popularity of foresight and scenario planning.

Though not explicitly related to megatrends, the United Nations 2030 Agenda for Sustainable Development and the 17 Sustainable Development Goals (United Nations, 2015) exhibits strong connections to megatrends discourses and is worth mentioning because it attracts widespread attention by think tanks and futurists. The 2030 Agenda covers aspects of economic, social, and environmental development and stresses the importance of multi-stakeholder partnerships at different levels (SDG 17). The 17 Goals were adopted by all member states of the United Nations in 2015. The German Agency for International Cooperation, die Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), states that "Global megatrends provide the backdrop for the 2030 Agenda for Sustainable Development. (GIZ, 2017).

The differences between the 2030 Agenda for Sustainable Development and megatrends frameworks lie in the degree of formality. The 2030 Agenda has been adopted by states and consists of detailed and hierarchically-structured goals and processes, including defined roles of custodian agencies and formal arrangements for monitoring and reporting on 232 indicators associated with 169 targets. The megatrends framework is more fluid and anarchical and focuses more on opportunities rather than highlighting problems or pointing to deficits, especially when used by consulting firms.

[1] *According to Web of Science, the number of articles published on the topic of "megatrends" has more than doubled from 2010 to 2021.*

4 Definition and evolution of think tanks

The term think tank was first used in military jargon. According to Ladi (2023) it was first used during World War II to describe a safe place where plans and strategies could be discussed. There is no uniform definition, and the meaning has changed over the past decades, especially in the context of the proliferation of private non-profit policy research organizations in the United States. The Merriam-Webster Dictionary describes a think tank as "an institute, corporation, or group organized to study a particular subject (such as a policy issue or a scientific problem) and provide information, ideas, and advice" (Merriam Webster Dictionary, 2022). The United Nations (2014) has published a report, "Thinking the Unthinkable: From Thought to Policy—The Role of Think Tanks in Shaping Government Strategy." Which refers to the increasing complexity and technical nature of policy problems, which play in favour of think tanks aiming to become more important in influencing policymaking.

However, "*what matters is not the label but the function, or functions, that think tanks fulfil*" (Mendizabel, 2021). Think tanks typically conduct research, engage in policy dialogue activities, and provide advice. More specifically, "they inform and educate decisionmakers and the public, promote ideas, advocate for change, hold decisionmakers to account, train the next generations of decisionmakers and create and nurture spaces for informed debate on matters of public interest "(Mendizabel, 2021: 1). In many countries, especially in the United States and in the United Kingdom but as well as at the level of the European Union, think tanks have developed into prime actors shaping agendas of policymakers and influencing decision-makers in business and finance. While it has been acknowledged that focused intellectual groups have played an influential role in governance for centuries (royal courts, elite societies, and business clubs, for example), think tanks are considered "a distinctly 20th century invention." (Barham & Barham jun., 2021, 1).

The Center for China and Globalization (CCG), a leading think tank in China and well-networked in the global think tanks community, describes the function of a think tank as follows:

> *"Through research reports, seminars, forums and meetings, as well as symposiums and proposals, think tanks play a role in setting agendas and conducting policy interpretation and research in the public arena. They also reflect public opinion and provide policy recommendations to the relevant government agencies through national consultation and democratic mechanisms." (CCG, 2021)*

Think tanks are sometimes perceived as elitist lobby organisations whispering recommendations to policymakers. Rand Corporation in the United States or Chatham House in the United Kingdom are two examples who have contributed to such images of think tanks among the general public in Germany and other countries. Whether or not think tanks are considered elitist organisations can depend on various factors such as their funding sources, their areas of focus, and the level of access they have to policymaking processes. Some argue that think tanks are elitist organisations because they are often funded by wealthy individuals or corporations, and their research and policy recommendations may not always align with the interests of the general public. Additionally, some think tanks may have a limited pool of experts who come from elite academic backgrounds or have ties to political elites. On the other hand, we have witnessed a proliferation of think tanks staffed with experts from diverse backgrounds which provide valuable research and analysis to help inform policy decisions. Many think tanks also prioritize engaging with a broader range of stakeholders and the public through events and publications. While recognising the growth of the think tanks sector, it is important to understand that the analytical capacity of many think tanks often depends on one or a few leading experts. In the field of future studies, the Association of Professional Futurists (APF) was founded in 2002 and has more than 500 members which act as analysts, consultants, and speakers and are affiliated to diverse think tanks, University departments and consulting firms.

Typologies of Think Tanks have been proposed by, among others, Weaver and McGann (2000) and Thunert (2006) who distinguished between (1) Academic Think Tanks, (2) Advocacy Organisations, and (3) Party Think Tanks. For example, in Germany, as in many European and Asian countries, academic think tanks are the dominant group while in countries of the Anglosphere private think tanks which are registered as nonprofits play a more important role. Such findings of Thunert (2006) on the difference between the think tank landscape in continental Europe and countries of the Anglosphere is still valid according to our observations and talks with experts. private advocacy organisations play a less significant role than in countries of the Anglosphere (Thunert 2006). In Germany, political foundations also play a significant role. They are affiliated to parties represented in the German Parliament and are largely funded by the Government and exercise different functions, including implementation of development cooperation projects as well as managing scholarships. For example, Konrad Adenauer Foundation which is affiliated to the long-time ruling Christian

Democratic Party (CDU), calls one of its five department, the Department Analysis & Consulting, a "think tank" while considering itself "more than a think tank".[1]

While the authors' own observations and exchanges with experts suggest that most established think tanks, are not much affected by the burgeoning megatrends discourse and analysis of future scenarios, there are some notable exceptions, such as the Bertelsmann Foundation in Germany, a leading private think tank, which has set up a Future Challenges team and publishes on megatrends (Bertelsmann Foundation, 2020).

More recently, we see a trend that non-profit organisations engaged in policy-oriented work prefer to work under the label of think tank rather than advocacy-organisations because advocacy work, especially involvement in campaign work, has become under scrutiny from government administration and courts in some countries, especially in the Global South and when it involved foreign funding. India and China are prime examples for this development. However, even some advocacy non-profit organisations in Western Europe face legal challenges. The Association pour la Taxation des Transactions financières et pour l'Action Citoyenne (Attac) , an activist organisation originally created to promote the establishment of a tax on foreign exchange transactions, lost its tax privileges in Germany due its involvement in political work (Beck Aktuell Januar 28, 2021).

The TTCSP (TTCSP 2021) has published the most authoritative report on Think Tanks over many years until the project was discontinued around the year 2021 when lead author James McGann tragically passed away. The TTCSP's GGTTI Report was designed "to identify and recognise centres of excellence in all the major areas of public policy research and in every region of the world." (TTCSP, 2021). The report provides the following definition of think tanks:

> *"Think tanks are public-policy research analysis and engagement organizations that generate policy-oriented research, analysis and advice on domestic and international issues, thereby enabling policymakers and the public to make informed decisions about public policy" (TTCSP, 2021).*

The number of think tanks included in the TTCSP GGTTI database has increased steadily over the years, from just over 5,000 in 2012 to over 8,000 in 2020. Growth was also significant outside the U.S. which still hosts by far the largest number of think tanks of any country in the world. Barham (2021, 2023) published a list of the most influential think tanks in academic influence which includes only one

[1] *Talk with Ariatani Wolff, a KAS scholarship holder on March 30, 2023.*

organisation in the U.S. among the top ten. Brookings, The Heritage Foundation and the Council on Foreign Relations (CFR) top the list.

We have witnessed a growth of think tanks in the Global South, especially in emerging markets and in countries which are looking toassert themselves in international relations. The Chinese government started to promote think tanks with Chinese characteristics soon after Xi Jinping took over as President in March 2013. Most Chinese think tanks are affiliated to single Ministries, but there are also more independent think tanks registered as non-profits and working on a variety of issues, with different Ministries and government agencies, especially on global issues. Xue, Zhu & Wanqu (2018) argue "*that the success of Chinese think tanks has been driven primarily by greater official recognition of their value, due to increasingly complex domestic and international problems stemming from a fragmented decision-making system….consequently, by late 2015, the new policies led to the selection of twenty five 'pilot high-end think tanks' and the establishment of the management system of think tanks in China." (pp. 49). Khan & Köllner (2018) analysed the growing role of Think Tanks in India and pointed out that "India's foreign policy think tank sector has gained in visibility and vibrancy due to new demand in the wake of India's expanding international stakes…*" Other reasons for the rise of think tanks in India include better funding and access to information, especially in the case of the Ministry of External Affairs (MEA). (Khan & Köllner. 2018).

The landscape of think tanks in a country often reflects characteristics of the political system of this country. Many ruling parties or coalition governments across the world interact closely with think tanks. Chile and two of its major think tanks, Centro de Estudios Públicos (CEP) and "Libertad y desarrollo" (LyD), are prime example for close political ties.

Many of the leading think tanks in the world, including Brookings (Washington D.C.), Bruegel (Brussels), Carnegie (Washington D.C.), Chatham House, (London), the Center for China and Globalization (Beijing), the World Economic Forum (WEF), and many others, have global outreach and focus more on global agendas than on national policy issues. The World Economic Forum (WEF), for example, has more than 13,000 members in 150 countries and supports the Global Shapers Community, a network of young people under the age of 30 working together to address local, regional, and global challenges. It convenes the Davos Forum and publishes the widely referenced Global Risks Report which has been extensively quoted by experts working in the field of megatrends analysis and future research.

Since the 1990s, we have seen a growing number of think tank reports and academic publications dealing with future analysis and megatrends. There are now many smaller and medium-sized institutes and associations that explicitly address megatrends, future research as ell as strategic forecast. The Association of Professional Futurists (APF) was founded in 2002 and has more than 500 members. It emerged as a network of practicing futurists who act as analysts, consultants, and speakers.

However, the TTCPS (TTCSP 2021) does not offer a category of think tanks with the thematic focus on megatrends, future research, or strategic forecast. There are many leading think tanks which employ a variety of methods and approaches to megatrends analysis, future research, and strategic foresight, and they play a critical role in shaping policy debates and influencing the direction of public discourse on the future

The number and diversity of organisations engaging in megatrends and future research is increasing. Expert opinion gathered in the context of our research also suggests that big data analytics and growing ICT capacities much facilitated megatrends analysis and future research and motivated smaller organisations to also engage with it. For example, we have come across a business case for developing AI based self-learning taxonomies for megatrends analysis. The Berlin-based start-up company Anacode is venturing into megatrends analysis based on big data and targets the financial industry and larger corporations with their product (Anacode, 2023).

5 Spotlights on diverse think tanks

This section introduces seven diverse think tanks from different countries and world regions which either explicitly engage in megatrends analysis and future research or work on issues highly relevant for megatrends analysis and future research. We selected the think tanks based on criteria of diversity related to regional, thematic, and methodological focus and dependent on their interest in participating in this research.

Interviews were conducted with the following think tanks:

- The Millennium Project (MP), Washington
  MP is an established global think tank with a strongly decentralized network of Nodes and an explicit focus on future research which is involved in the United Nations 2024 summit on the future.
- Copenhagen Institute of Future Studies (CIFS), Copenhagen.

CIFS is one of the earliest European think tanks with high-level expertise on future research and strategic foresight and is implementing projects with diverse stakeholders as well as offering training courses.

- Green Economy Coalition (GEC), London.
  GEC is the world's largest alliance for green and fair economies and has 60 organisational members including trade unions, businesses, NGOs, United Nations agencies and citizen's groups and established eight green economy hubs in Brazil, India, Mongolia, Peru, Senegal, South Africa, Uganda and Caribbean region.
- Center for China and Globalisation (CCG), Beijing.
  CCG is a well-established, globally recognised and well networked independent nongovernmental Chinese think tank with a broad agenda which focuses on economic, trade, and geopolitical issues and is engaged in dialogue with leading Chinese companies, universities and government departments of several ministries.
- Centre for Civil Society (CCS), Delhi
  CCS is an established and internationally well-networked advocacy-oriented non-profit organisation, and is shaping policy discourses in the field of social and economic development and influenced law-making processes in India.
- Cultural Infusion (CI), Melbourne
  CI is considered a global leader in diversity research and is working on cultural issues in cooperation with many organisations and big companies, including UNESCO.
- 4Sing, Hamburg
  4Singh is a for-profit think tank that offers consulting and coaching services in foresight and strategy development in the field of security and sustainability governance for public and private sector organisations across the world.

We examined their involvement in megatrends analysis and future research and their work on issues related to major discourses relevant for megatrends analysis and future research. We learned about their different orientations, approaches and changes in their strategies. The scope of this paper does not allow to present the work of these think tanks in detail. Thus, only brief summaries are provided focusing on how these organisations position themselves thematically and within

the landscape of global think tanks and which strategies they adopt to maximise their impact.

5.1 Millennium Project (MP), Washington

MP has an explicit focus on megatrends analysis. Its 15 Global Challenges provide a framework to assess the global and local prospects for humanity and contribute much to knowledge dissemination on megatrends. The description of the trends is updated each year, since 1996.

MP, under the leadership of Jerome Glenn, puts a lot of emphasis on having a truly global approach, "a global representation" and aims to avoid ideological or country/region bias. MP works through and with "Nodes" (currently 71 across the globe) which enable the MP to quickly access intelligence and to collect analysis and assessments from around the world. It is involved in the preparation of the United Nations Summit of the Future in 2024 and has a strong motivation to guide and lead organisations and experts in providing policy advice in the field of megatrends and future studies.

5.2 Copenhagen Future Institute, Copenhagen

CIFS work contributes towards democratising future thinking and working for common goods. It stresses its ability to convene broadly and to engage with diverse stakeholders and is currently putting emphasis on engaging more with ethical dimensions of future developments. New projects relate to bringing future thinking principles to young people, inserting them into educational systems and developing open-source products for young generations. In cooperation with companies, CIFS stresses the importance of integrating anticipatory leadership thinking in corporate cultures rather than just creating well-designed but gimmick-like foresight tools. CIFS considers itself as a pioneer organisation in future research. It is aware of the current boom in forecasting and megatrends analysis which may provide opportunities for networking but also some quality related risks for the profession. CIFS hosts a UNESCO Chair in Anticipatory Leadership and Futures Capabilities.

5.3 Green Economy Coalition (GEC), London

GEC is an influential green economy network of organisations promoting the green economy and just transition to a sustainable future across countries and

regions. Under the previous leadership of Emily Benson and the current leadership of Oliver Greenfield, the work of the coalition relates to the megatrends framework and to system risks. GEC puts a special focus on the intersection of megatrends. The organisation and its network contributed to make the Green Economy a megatrend in itself, and they aim to pro-actively shape megatrends by forging new alliances. Knowledge management is centred around its informative website which comments on recent developments, e.g., reflections on IPCC climate science reports. The GEC realises that policymakers will probably not move beyond incremental change. Thus, their strategy focuses more on new mechanisms of citizen engagement with a purpose to renegotiate social contracts for the green and just transition. GEC is realising that the climate imperative poses challenges to inclusive and democratic governance. Thus, it is crucial to find solutions addressing big social and political divides between and within countries for progressing with the sustainability transition and addressing systemic risks.

5.4 Center for China and Globalisation, Beijing

CCG has a broad agenda relating to many global megatrends and topics of future research with a focus on economic and trade policies. In the context of extended and sharpened interest in geopolitics and geoeconomics, CCG has got growing global recognition as a non-governmental Chinese think tank and is considered to have a huge knowledge base on internal relations. It benefited from the interest of the Chinese political leadership in policy-oriented academic work on global issues but considers itself as politically independent organisation. CCG is organising many dialogue events, contributes to books publications and publishes newsletters which reach a large audience in China and other countries. Policy advice is provided in the context of many high-level conferences and through direct contact to policymakers. CCG entertains good relations with the Chinese governments and works with several ministries and large companies. Under the leadership of co-founder and President Wang Huiyao, CCG has much contributed to disseminate the concept of think tank work in China and beyond.

5.5 Centre for Civil Society, Delhi

CCS's mission is to "advance social change through public policy…" Its work is based on three pillars: education, livelihood, and governance. CCS provides policy training with the purpose to promote choice and accountability across the private

and public sectors. To translate policy into practice, CCS engages with policy and opinion leaders through research, projects, and policy training.

Under the leadership of Chief Executive Officer (CEO) Lakshmi Sampath Goyal who previously served as the CEO of the India Sanitation Coalition, the organisation has further strengthened its relationship with think tanks and other non-profit organisations networking on the national and international level.

CCS has influenced many policy-making and law-making processes in India, and closely follows and guides economic, social, and political discourse on India's future. While CCS has no explicit focus on megatrends, future studies, or strategic foresight, it is interested in such topics and familiar with leading discourses related to megatrends. CCS emphasises that it always aims to stay on top of the agenda of key social and governance issues in India. It is internationally well-networked due to affiliations with various organisations, including liberal think tanks and foundations in the West which have provided funding support to CCS.

5.6 Cultural Infusion

Peter Mousaferiadis founded Cultural Infusion in Melbourne in 2002. The organisation has attracted some outstanding talents and established a good track record in the field of intercultural understanding. By 2015, Cultural Infusion expanded into the digital world, releasing award-winning apps, Joko's World and Sound Infusion. CI developed and promotes the Diversity Atlas, an online survey which is used as part of training programs to assess and monitor diversity within companies and organisations by measuring demographics and intersectional data across the four interconnected cultural diversity pillars: (1) Religion & Worldview (7,900+ religions, branches and denominations); (2) Country of Birth (UN list of countries and independent territories); (3) Language (7,900 + all spoken languages worldwide); and (4) Ethnicity & Race (8,000 + different global ethnic groups). It is developing comprehensive data sets on diversity and cooperation with governments and multinational corporations in their effort to more adequately recognize and promote diversity. CI has made contributions to promote the global megatrend of diversity and has participated in a megatrends project.

5.7 4Sing, Hamburg

4Sing is a network of foresight experts working in different countries and guided by Adrian Taylor, a foresight expert, strategist, change agent and business

coach with extensive and diverse international experience. 4Sing works about equal parts for the government and non-profit clients. 4sing experts focus on strategic foresight and strategy development targeting different industries, including the energy, utility, chemical, and automotive industry. 4Sing has worked in different countries across the globe, especially in Europe and Asia. It uses technological tools to enhance and visualise its scenario and system development work. While its scenario and strategic foresight work with public sector or non-profit clients sometimes involves external parties or is organised as a multi-stakeholder event, the more strategy-focussed consulting work with the private sector usually just involves different departments within one company as strategy development is sensitive in a competitive business environment. 4Sing cooperation and networking partners include organisations working in the field of design thinking, horizon scanning, action research and strategic foresight, especially EIDOS, the Global X network, Cognitive Edge, Futurescaper, futuribles, shapingtomorrow and 4strat.

6 Conclusion

Today it is easier to learn, analyse, and forecast future developments in different parts of the world as we live in a much more globalised world with better access to data, information and quick survey and networking tools. Thus, we are witnessing a significant growth of larger and smaller think tanks engaged in explicit analysis of megatrends, future studies, and strategic foresight or working on issues which would qualify as megatrends issues. The many diverse think tanks are using different conceptual frameworks, methodologies, and tools. This may, at least in the long run, lead to a proliferation of new methodologies and enhance the quality of megatrends analysis and future research. Future literacy is likely to receive more attention by international organisations as well as universities and the education and consulting industry.

The majority of established think tanks, however, are not deeply affected by the burgeoning megatrends discourse and does not specifically engage in future studies or uses strategic foresight tools. There are some notable exceptions like the Bertelsmann Foundation, a large German think tank, which has recently taken-up megatrends analysis and forecasting.

Most of the leading think tanks are situated in the United States and EU countries but other parts of the world are catching up, including China and India. The knowledge management and policy advice strategies of think tanks usually follow their function and are diverse. Many of them concentrate on producing

analytical reports including data analysis and policy recommendations, engaging in multi-stakeholder exchanges, and organising conferences and other dialogue events. The UN future summit 2024 reflects the growing attention paid by international organisations to future research and their interest to engage with think tanks and megatrends experts in exchanges and dialogue events on the future of humanity.

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Relationship between Lifelong Learning and Income, Wages and Labour Productivity Growth

Maja Baćović*

Department of Economics
University of Montenegro
Jovana Tomasevica 37, Podgorica, Montenegro

Nikola Milović

Department of Economics
University of Montenegro
Jovana Tomasevica 37, Podgorica, Montenegro

* *Corresponding author*

Abstract

In the era of technological progress, it is necessary to have a skilled workforce with abilities to react to market changes. The empirical literature relies almost exclusively on school attainment measures of human capital, such as years of schooling. As lifelong learning programs may increase the skills of a labour force, the research on the participation of labour force in lifelong learning programs and its impact on income, wages, and productivity should contribute to the existing literature. The aim of this study is to estimate the impact of the participation of labour force in lifelong learning programs on income, wages and productivity, as empirical analysis shows high heterogeneity in the participation rate among European countries. Descriptive statistical analysis of a sample of 35 European countries for the period 2006-2021, shows that, on average, 10.8% of the EU (27) population aged 25-64 years participated in education and training programs in 2021, with Finland and Sweden having the highest participation rates in 2021 (30.5% and 34.7%), while the Balkan countries have the lowest participation rates (1.8 in Bulgaria and 4.8% in Serbia in 2021, 2.7% in Montenegro and 2.6% in North Macedonia in 2020). Applying the OLS model to the sample of thirty-five European countries and the period from 2006 to 2021, with growth in the participation rate in education and training (persons in the labour force, 25-64 years) as an independent variable, while the growth in GDP per capita, labour productivity, and wages are dependent variables, we show that growth in the participation rate in education and training by one percentage point leads to GDP per capita growth by 6 percentage points, nominal labour productivity growth by 5.5 percentage points, and wages growth by 2.6 percentage points. Productivity growth is a prerequisite for long-run economic growth in all countries, and it is not possible without investment in knowledge, either in education or investment in research which will result in innovation and technological progress. Lifelong learning is an important part of the overall system of education and increases human capital, and should be given the highest relevance in the

overall education process. For medium-income European countries, to converge to the income level of developed European countries, it is necessary to increase its technological readiness, quality of the workforce, and productivity. The growth in human capital is therefore indispensable, not only through formal education but through lifelong learning also.

Keywords: Lifelong learning, Income, Wages, Productivity, Europe

Paper type: Academic research paper

1 Introduction

In the era of technological progress, frequent job changes, and fluctuations in the labour market, it is necessary to have a workforce that has the skills and abilities to react to market changes. Traditional skills and knowledge are changing workers' values and importance and younger staff have the advantage of having the skills needed to react to the changes. This trend is observed in all economies of the world, both developed and developing. International Labour Organization - ILO (2021), concluded that "skills mismatches are a growing challenge in today's labour markets, with many consequences for workers, businesses and the future of work.

The solution to the lack of a workforce that has skills and abilities in compliance with existing technological achievements can be seen in constant education and training, through various forms. The empirical literature relies almost exclusively on school attainment measures of human capital, such as years of schooling. Therefore, the research on the participation of labour force in lifelong learning programs and its impact on income, wages, and productivity should fill the existing research gap.

As emphasised by the ILO (2021), "skilling, reskilling and upskilling throughout all stages of life is the precondition and an accelerator for people to access decent work opportunities and enable smooth transitions into labour markets and within labour markets". Further, they conclude that skill development and lifelong learning are fundamental enablers of decent work, productivity, and sustainability that can raise the value and output of labour, empowering the lives of workers and enriching societies.

An empirical analysis of a sample of 35 European countries for the period 2006-2021 shows that, on average, 10.8% of the EU (27) population aged 25-64 years participated in education and training programs in 2021, with the highest participation rate observed in Finland and Sweden (30.5% and 34.7%), and the

lowest in the Balkan countries (1.8 in Bulgaria and 4.8% in Serbia in 2021, 2.7% in Montenegro and 2.6% in North Macedonia in 2020). Based on the same sample and the period, the research shows that a high heterogeneity was observed in GDP per capita, annual wages, and labour productivity. Therefore, it is of immense importance to investigate determinants of income, productivity and wages, so countries will lower income may converge to more developed countries. Lifelong learning may contribute to income convergence.

At the European Union level, lifelong learning is recognized as an important determinant of productivity and income growth. The European Commission defines lifelong learning as "all learning activities undertaken during life with the aim of improving knowledge, skills and competences at the personal, civic, social, and/or employment level". It involves the acquisition of all kinds of interests, abilities, and qualifications from pre-school age to post-retirement age, through formal and informal learning, to encourage continuous development and improvement of professional and personal plans. Important determinants in the development of the lifelong learning policy and legislative framework in Europe include the Bologna process, numerous initiatives of the European Union within the framework of the Lisbon strategy, and increasing participation in the financing of lifelong learning programs. In line with the headline target of the European Pillar of Social Rights Action Plan, 60% of all adults are expected to participate in training every year by 2030. Actions and initiatives at the European level provide support to national institutions and individuals to increase adult's participation in learning and training activities. They enhance understanding of how to respond to challenges in the field of adult learning and enable better exchange of knowledge and experiences between countries.

A resolution adopted by the Council of the European Union (EU) on 29 November 2021, on a new European Agenda for Adult Learning, highlights the need to significantly increase adult participation in formal, non-formal, and informal learning. The Agenda outlines a vision of how adult learning should develop in Europe by 2030 in the following five priority areas: governance of adult learning – with a strong focus on whole-of-government national strategies and stakeholder partnerships; supply and take-up of lifelong learning opportunities with sustainable funding; accessibility and flexibility – to adapt to the needs of adults; quality, equity, inclusion and success in adult learning – emphasizing the professional development of adult learning staff, the mobility of both learners and staff, quality assurance, and active support to disadvantaged groups; and green and digital transitions and related skill needs.

The policy framework and support for the lifelong learning concept are provided through the following documents: The Lisbon Strategy (2000) – includes a program for the modernization of higher education through the emphasis on knowledge and innovation and the introduction of instruments aimed at strengthening the European research area; Charter of the European Association of Universities on lifelong learning[1]; the Copenhagen process (2002), aimed at establishing the recognition and transparency of the standards and content of professional qualifications, compatibility between the qualification frameworks of member states, and the introduction of quality assurance measures for mutual recognition of qualifications and linking of knowledge acquired in any period; Education and training in 2020, a document containing a framework with the spectrum of education and training from the perspective of lifelong learning; The European Qualifications Framework, a reference framework for lifelong learning, which enables the comparison of educational and professional qualifications in European countries by linking degrees, diplomas, and education in countries with a common European framework.

The study is comprised of five sections. After the introduction, in the second section, the most relevant findings from the literature were presented. In the third section trends in lifelong learning in Europe are analysed. The methods and empirical results of the study are presented in the fourth section, followed by a discussion and a conclusion.

2 Literature review

The literature on relevance of human capital for productivity and economic growth is waste, but relies almost exclusively on mandatory forms of education. Still, several studies analyse the significance of lifelong learning.

Becker (1993), pointed out that workers increase their productivity by learning new skills and improving old ones while employed, and discus general and specific trainings. He concluded that training has an important effect on wage and income. Aceleanu (2012), studied lifelong learning in Romania and found that implementing lifelong learning programs, can recover the gaps compared to developed countries, and improve work efficiency and employment. Barış (2019), states that it is imperative that lifelong learning at the forefront of lifelong

[1] *The European University Association (EUA) unveiled a 'European University Charter for Lifelong Learning' at its autumn conference in Rotterdam, the Netherlands, on 25 October 2008. Written after consulting some 800 universities and 34 conferences of university rectors that are members of the EUA, the charter aims to back universities in Europe in developing their special role as institutions for lifelong learning.*

and supporting methods be incorporated into the programs of the countries and the development and implementation of educational policies. Economic strengthening is possible through the training of qualified personnel. Wiederhold (2015), emphasizes that "It is essentially undisputed that the human capital of a nation accumulated through schooling and lifelong learning is crucially important to the economy's innovative capacity and ability to compete in the globalized world of the 21st century. A substantial body of research has shown that human capital has positive effects not only on individuals' success in the labour market, but also on their general well-being. However, the empirical literature relies almost exclusively on school attainment measures of human capital, such as years of schooling. Due to differences in the quality of schooling over time and across countries, these measures might be poor approximations of effective human capital. Moreover, measures of educational attainment just reflect an individual's human capital at the end of formal schooling, which may not be good indicators of effective human capital when individuals need to constantly adapt their skills to structural and technological change throughout their entire working life." He pointed out that several studies showed that a good governance framework of the school system and effective teachers are important for achieving high levels of skills among students. However, continuing structural and technological changes in the economies require skill adaptations and the process of lifelong learning after school. This puts focus on policies that ensure that skills are effectively retained and used. Furthermore, skills also accumulate through regular practice. This learning-by-doing seems to develop skills at a faster rate when there is substantial novelty and challenge in the scope of the everyday activities undertaken by employees. Brine (2006), found that low-knowledge-skilled learners are at "risk", in opposite to high-knowledge-skilled learners. Chiam, Norbaini and Nur (2011) show that human capital and learning by doing play significant role in economic growth, and are powerful catalyst that promotes economic growth. Aleandri and Refrigeri (2013) pointed out that a promotion of efficient lifelong learning requires financial and economic incentives, also a widespread cultural change.

3 Lifelong learning, income, labour productivity and wages in Europe – an empirical analysis

An empirical analysis of a sample of 35 European countries for the period 2006-2021 was conducted based on indicators and data presented in Table 2. The analysis shows that, on average, 10.8% of the EU (27) population aged 25-64

years participated in education and training programs in 2021, which is 38% higher than in 2006 (7.8%). The highest increase in the participation rate was observed in Romania (217%), Portugal (207%), Estonia (183%), and Luxemburg (116%), while in the United Kingdom, it decreased by 54% in 2019 compared to 2006, in Denmark by 24% in 2021 compared to 2006 and by 14% in Iceland (Table 6-annex).

Finland and Sweden have the highest participation rates in 2021 (30.5% and 34.7%), while the Balkan countries have the lowest participation rates (1.8 in Bulgaria and 4.8% in Serbia in 2021, 2.7% in Montenegro and 2.6% in North Macedonia in 2020).

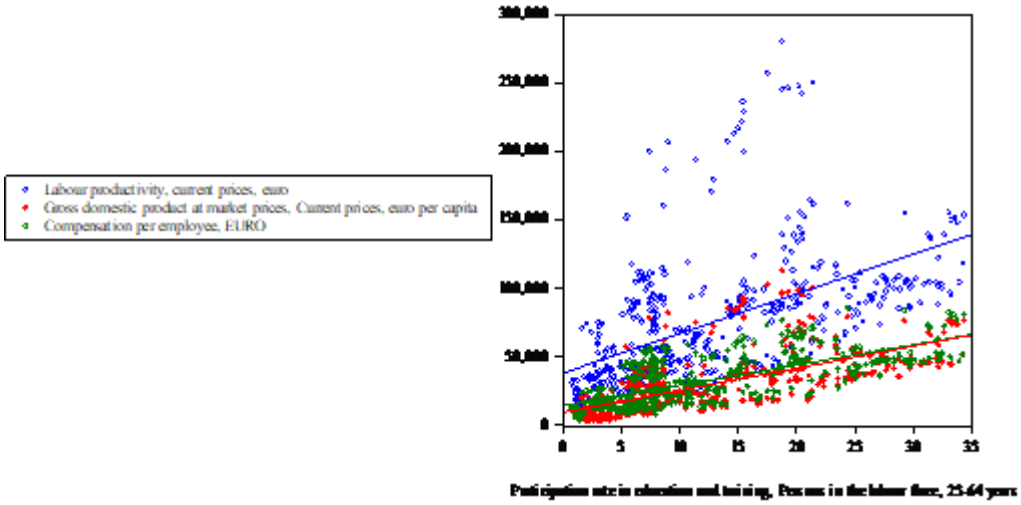
High heterogeneity was observed in GDP per capita, annual wages, and labour productivity among European countries from the sample (Table 1). Descriptive statistics analysis for 35 European countries and the period from 2006 to 2021, shows that, although the average GDP per capita (PPP) was 28.6 thousand €, at the individual country's level, it ranges from 8.9 thousand € (minimum) to 88.4 thousand €. The same was observed for GDP per capita (current €), labour productivity, and percentage of labour participating in training.

Table 1. Descriptive statistics for selected indicators, panel mean (35 European countries, 2006-2021)

	GDP per capita, PPP €	**GDP per capita (current €)**	**Labour productivity (current €)**	**Wages (annual), current €**	**Participation in training**
Mean	28681.36	30120.79	73725.37	32302.11	12.11858
Median	26673.10	23990.00	65139.25	28284.80	8.700000
Maximum	88415.20	112780.0	280572.0	83700.20	34.40000
Minimum	8951.900	3560.000	10417.62	3382.700	0.800000
Std. Dev.	12742.98	20611.82	46523.02	18172.44	8.793487
Skewness	1.711744	1.257350	1.487916	0.499052	0.840078
Kurtosis	7.175767	4.415229	5.964508	2.361342	2.670761
Jarque-Bera	581.9312	166.1848	352.1424	28.02342	58.50431
Probability	0.000000	0.000000	0.000000	0.000001	0.000000
Observations	479	479	479	479	479

Source: Authors' calculations based on Eurostat's data

Further analysis shows that a positive linear relationship exists between the participation rate in education and training and income (GDP per capita), wages, and labour productivity (Graph 1).



Graph 1. Participation in education and training, income, wages and labour productivity
Source: Author's calculations based on Eurostat data

4 Data and methodology

4.1 Data and sample

In this study, we used data from thirty-five European countries, from 2006 to 2021. The data have an annual frequency. The indicators used in this study are listed in Table 2.

Table 2. List of variables

Indicator	Source		Date extracted
Participation rate in education and training, Persons in the labour force, 25-64 years	Eurostat	Participation rate in education and training (last 4 weeks) by sex and labour status [trng_lfse_02]	Oct-22
Gross domestic product at market prices, Current prices, purchasing power standard (PPS, EU27 from 2020) per capita	Eurostat	Main GDP aggregates per capita [nama_10_pc]	Oct-22
Gross domestic product at market prices, Current prices, million euro	Eurostat	GDP and main components (output, expenditure and income) [nama_10_gdp]	Oct-31
Employees national concept, Thousand persons	Eurostat	Population and employment [nama_10_pe]	Oct-31
Compensation per employee, EURO	European Commission	Labour productivity and unit labour costs [nama_10_lp_ulc]	Oct-22

Source: Author's compilation

4.2 OLS estimation

To estimate the impact of lifelong learning on the growth in standard of living, we estimated OLS where an annual change in GDP per capita (PPS, EU27 from 2020) - $\Delta GDP_{pc,t}$ is the dependent variable, while growth in the participation rate in education and training (persons in the labour force, 25-64 years) - $\Delta L_{pt,t}$ is an independent variable (Equation 1).

$$\Delta GDP_{pc,t} = f(\Delta L_{pt,t}) \qquad (1)$$

The estimated results are presented in Table 3.

Table 3. OLS estimation - Equation 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\Delta L_{pt,t}$	0.060960	0.011012	5.535784	0.0000***
C	0.025737	0.002176	11.82942	0.0000***

*** p<.01, ** p<.05, * p<.1

Source: Author's estimations

The estimated results show that growth in the participation rate in education and training by one percentage point leads to GDP per capita growth by 6 percentage points.

To estimate the impact of lifelong learning on the growth in nominal labour productivity per employee (GDP per total number of employees, current prices, €), we estimated OLS where nominal labour productivity per employee growth - $\Delta LP_{pc,t}$ is the dependent variable, while growth in participation rate in education and training (persons in the labour force, 25-64 years) - $\Delta L_{pt,t}$ is an independent variable (Equation 2).

$$\Delta LP_{pc,t} = f(\Delta L_{pt,t}) \qquad (3)$$

The estimated results are presented in Table 4.

Table 4. OLS estimation - Equation 2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\Delta L_{pt,t}$	0.055788	0.013309	4.191662	0.0000***
C	0.025367	0.002633	9.632433	0.0000***

*** p<.01, ** p<.05, * p<.1

Source: Author's estimations

The estimated results show that growth in the participation rate in education and training by one percentage point leads to nominal labour productivity per employee (current prices, €) growth by 5.5 percentage points.

To estimate the impact of lifelong learning on the growth in wages (compensation per employee), we estimated OLS where wages - $\Delta W_{pe,t}$ is a dependent variable, and growth in the participation rate in education and training (persons in the labour force, 25-64 years) - $\Delta L_{pt,t}$ is an independent variable (Equation 3).

$$\Delta W_{pe,t} = f(\Delta L_{pt,t}) \qquad (3)$$

The estimated results are presented in Table 5.

Table 5. OLS estimation - Equation 3

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\Delta L_{pt,t}$	0.026896	0.012985	2.071299	0.0389**
C	0.028840	0.002598	11.10002	0.0000***

*** p<.01, ** p<.05, * p<.1

Source: Author's estimations

The estimated results show that growth in the participation rate in education and training by one percentage point leads to a 2.6 percentage point increase in wages.

5 Discussion and conclusion

Economic theory provides strong evidence that points to a strong link between the expansion of scientific and technical knowledge that enables productivity and income growth in the long run. Becker (1993), pointed out the importance of investing in human capital (education, training, and improvement of employees) for the growth of productivity and income. Romer (2001), in his analysis of the impact of knowledge accumulation on economic growth, pointed to the possibility that one of the reasons for the low level of income in less developed countries is their inability to use already developed technologies. Empirical findings by Denison (1985), show that growth in the level of education of the workforce in the USA contributed to a quarter of the total economic growth achieved in the period from 1929 to 1982.

Productivity growth is a prerequisite for long-run economic growth in all countries, and it is not possible without investment in knowledge, either in education or investment in research which will result in innovation and

technological progress. Lifelong learning is an important part of the overall system of education and increases human capital, therefore should be given the highest relevance in the overall education process. The goal of EU policies and development documents is to **achieve 60 percent participation of employees in training programs** by 2030.

For medium-income European countries, to converge to the income level of developed European countries, it is necessary to increase its technological readiness, quality of the workforce, and productivity. This affects the growth of earnings, the growth of the company's profitability, and the prosperity of the country as a whole. The growth in human capital is therefore indispensable, not only through formal education but through lifelong learning also.

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Annex

Table 6. Participation rate in education and training, population (25-64)

GEO/TIME	2006	2010	2011	2019	2020	2021	Total growth[1]
European Union - 27 countries (from 2020)	7.8	7.8	8.1	10.8	9.1	10.8	1.38
Belgium	7.8	7.4	7.4	8.2	7.4	10.2	1.31
Bulgaria	1.6	1.6	1.6	2.0	1.6	1.8	1.13
Czechia	5.8	7.8	11.6	8.1	5.5	5.8	1.00
Denmark	29.2	32.7	32.3	25.3	20.0	22.3	0.76
Germany	7.5	7.8	7.9	8.2	7.7	7.7	1.03
Estonia	6.5	11.0	11.9	19.6	16.6	18.4	2.83
Ireland	7.4	7.1	7.2	12.6	11.0	13.6	1.84
Greece	2.1	3.3	2.8	3.9	4.1	3.5	1.67
Spain	10.7	11.2	11.2	10.6	11.0	14.4	1.35
France	6.4	5.0	5.5	19.5	13.0	11.0	1.72
Croatia	3.1	3.0	3.1	3.5	3.2	5.1	1.65
Italy	6.1	6.2	5.7	8.1	7.2	9.9	1.62
Cyprus	7.4	8.1	7.8	5.9	4.7	9.7	1.31
Latvia	7.3	5.4	5.4	7.4	6.6	8.6	1.18
Lithuania	5.0	4.4	6.0	7.0	7.2	8.5	1.70
Luxembourg	8.3	13.5	13.9	19.1	16.3	17.9	2.16
Hungary	4.0	3.0	3.0	5.8	5.1	5.9	1.48
Malta	5.5	6.2	6.6	11.9	11.0	13.9	2.53
Netherlands	15.7	17.0	17.1	19.5	18.8	26.6	1.69
Austria	13.2	13.8	13.5	14.7	11.7	14.6	1.11
Poland	4.7	5.2	4.4	4.8	3.7	5.4	1.15
Portugal	4.2	5.7	11.5	10.5	10.0	12.9	3.07
Romania	1.5	1.4	1.6	1.3	1.0	4.9	3.27
Slovenia	15.2	16.4	16.0	11.2	8.4	18.9	1.24
Slovakia	4.3	3.1	4.1	3.6	2.8	4.8	1.12
Finland	23.1	23.0	23.8	29.0	27.3	30.5	1.32
Sweden	18.8	24.7	25.3	34.3	28.6	34.7	1.85
Iceland	27.9	25.4	26.4	22.2	20.3	23.9	0.86
Norway	19.1	18.2	18.6	19.3	16.4	19.5	1.02
Switzerland	22.5	29.7	28.9	32.3	27.6	22.8	1.01
United Kingdom	27.4	20.1	16.3	14.8	:	:	0.54

[1] *Ratio between 2021 and 2006, where available. If not available, the ratio between the latest and the first available data (2010, 2011, 2019, 2020)*

Montenegro	:	:	2.4	2.5	2.7	:	1.13
North Macedonia	2.3	3.5	3.6	2.8	2.6	:	1.13
Serbia	:	4.0	3.5	4.3	3.7	4.8	1.20
Turkey	2.0	2.9	3.4	5.7	5.8	:	2.90

Source of data: Eurostat, Unit: Percentage, Age: From 25 to 64 year

Digital Spiral Model of Knowledge Creation and Encoding its Dynamics

Igor Zatsman

Institute of Informatics Problems
FRC CSC RAS
44/2 Vavilov str., Moscow, 119333
Russia

Abstract

The paper is conceptual as it aims to extend the well-known Nonaka's spiral model in order to develop a model of knowledge creation (MKC) using information technology. The need of developing the MKC is due to the increasing ubiquity of information technology in the field of knowledge management. The three grounds of the MKC development are considered. The first is human-computer symbiosis combining the automatic (computer) and expert stages of goal-oriented new knowledge discovery. The first ground determines the usage of three media of different nature (mental, informational, and digital ones) during knowledge discovery. The second ground extending Nonaka's model is the specification of digital potential sources of new knowledge which should be relevant to the goal of its discovery. The third ground is explicit linkages between new concepts (individual and group) and their digital sources. To define the MKC the paper describes some notions (knowledge, concept, mental data, sensory perceived and digital information, sensory perceived and digital data, and digital knowledge representations). The MKC covers three processes of Nonaka's model (internalisation, socialisation, externalisation), its modified fourth process (combination), and includes new processes for discovering new concepts in digital potential sources of new knowledge. The principal feature of the MKC is encoding knowledge dynamics in computer system knowledge bases fixing individual and group concepts, their digital sources, and concept generation time points. The proposed model is the foundation of evolving previous version of the DIKW hierarchy because the MKC processes clarify linkages between data, information, and knowledge.

Keywords – Knowledge creation, Knowledge dynamics, Spiral model, DIKW hierarchy

Paper type – Academic Research Paper

1 Introduction

In 2015, a report was published with a forecast of technological development (WEF, 2015). It was prepared under the auspices of the World Economic Forum. Approximately 800 experts and executives from the information and communications technology sector contributed to this report. The report containing the results of their survey includes the list of new information technologies which predetermine the fundamental nature of the social and economic transformation, called the "Fourth Industrial Revolution" (Schwab, 2016).

Modern information technologies that control the processes of production and consumption generate huge amounts of digital data, which are positioned as potential sources of creating new knowledge. According to Di Maria et al. (2018), "The rise of network technologies allows organisations to acquire and manage knowledge from a wider set of sources within and beyond the organisational boundaries <…> the Industry 4.0 revolution stresses the huge potentialities in data generation related to a) a wider set of processes, including operations and consumption; b) a more detailed level as well as a higher volume of data than before". According to Manesh et al. (2021), "to truly benefit from this digital transformation, organizations should improve their KM approaches so they can scan and detect meaningful pieces of information and develop more sophisticated uses of this knowledge".

Huge amounts of digital data necessitate reconsidering the field of knowledge management in its theoretical core and developing methods and models of knowledge creation using information technology. The purpose of the paper is to develop the model of knowledge creation (MKC), extending the well-known Nonaka's spiral model (Nonaka, 1991; Nonaka and Takeuchi, 1995), and to create the medium version of the DIKW (data, information, knowledge, wisdom) hierarchy. The principal aim of developing the MKC is to describe goal-oriented discovery of new knowledge in digital data.

2 The spiral model and its extending

2.1 The spiral model and its variants

To create the MKC, we will first briefly describe the spiral model and its variants. At present, the spiral model of knowledge creation (= SECI model) is one of the most popular. Two categories of knowledge are determined in this model:

individual knowledge and group knowledge. Each of these categories is divided, in turn, into two sub-categories: explicit knowledge and tacit knowledge. The spiral model includes the following four types of knowledge (Nonaka, 1991; Nonaka and Takeuchi, 1995):

- Individual tacit knowledge
- Group tacit knowledge
- Group explicit knowledge
- Individual explicit knowledge

In the model, besides these four types of knowledge, the following four transformation processes are defined: Socialisation-Externalisation-Combination-Internalisation (SECI). By definition, each spiral turn of knowledge creation includes the sequence of processes (Fig. 1): socialisation → externalisation → combination → internalisation → socialisation (as the beginning of the next spiral turn).

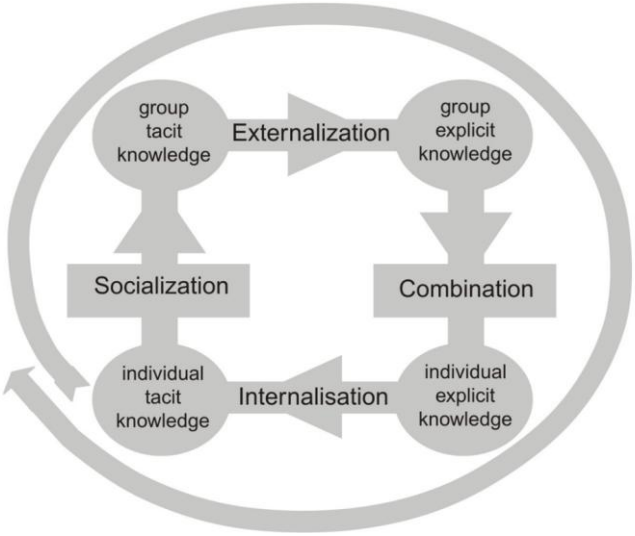

Figure 1. The spiral model (Nonaka, 1991)
(this diagram was taken from (Wierzbicki & Nakamori, 2006))

According to C. Bratianu (2019), "The SECI model does not contain time as an explicit variable. <…> The model contains time implicitly since any transformation needs time, but it is a generic time without any possibility of measuring it". Therefore, in this qualitative model, one can already see three dimensions of the processes of knowledge creation:

- The socialisation dimension has two nominative categories (individual and group)

- The temporal dimension is implied in the spiral turns of knowledge creation
- The explicitness dimension also has two nominative categories (tacit and explicit)

Some models describe knowledge dynamics with another number of nominative categories in the socialisation dimension and with one or two explicit temporal dimensions. For example, Nissen (2006) extended the spiral model to integrate two temporal dimensions: "*life cycle* and *flow time*. *Life cycle* refers to the kind of activity (e.g., creation, sharing, application) associated with knowledge flows. *Flow time* pertains to the length of time (e.g., minutes, days, years) required for knowledge to move from one person, organization, place, or time to another". The socialisation dimension identifies three nominative categories (individual, group, and organisation). All four dimensions (socialisation, two temporal, and explicitness) for characterising knowledge flows can be employed collectively to visualise the spiral turns of knowledge creation. One name is changed here for clarity (i.e., Nissen uses the term *reach* instead of *socialisation*).

Another model with more nominative categories in the socialisation dimension was proposed by Wierzbicki and Nakamori (2006, 2007). Like Nissen (2006), they also offer three nominative categories, but instead of organisation knowledge, their model (hereafter the WN model) includes conventional knowledge:

- individual knowledge,
- group knowledge,
- conventional knowledge (knowledge of humanity).

Wierzbicki and Nakamori also subdivide each category into tacit and explicit knowledge, thus obtaining six knowledge types. They define nine transformation processes that provide knowledge creation, including socialisation, externalisation, combination and internalisation. Eventually, to build their knowledge creation model, they operate with six types of knowledge, three emotion components (individual, group, and conventional), and identify nine types of transformations of knowledge types. Eight more transformations of three emotion components, as well as between knowledge and emotions have been defined. For example, between individual tacit knowledge (individual intuition in the WN model) and individual emotions, they defined two transformations, namely, motivation: individual emotions → individual intuition and determination: individual intuition → individual emotions (Wierzbicki and Nakamori, 2006: p. 75).

Before describing the MKC, we list the principal features of the models briefly discussed above. Their strengths are that they explicitly or implicitly use three or

four dimensions to describe the dynamics of knowledge. For all models in the explicitness dimension, two nominative categories are defined (tacit and explicit). If we add conventional knowledge from the WN model to the three Nissen's nominative categories (2006), then in the socialisation dimension we get four nominative categories (individual, group, organisational, and conventional). The weakness of all models is that any sources of new knowledge are not defined.

2.2 Extending the spiral model

The most appropriate approach to create the MKC is to join the model of an information system storing and processing digital potential sources of new knowledge with the spiral model describing the dynamics of knowledge (= digitalising the spiral model). Earlier, the ITO model was created during the digitalising the spiral model for solving two problems of new knowledge generation based on this approach (Zatsman, 2021):

- Discovering new meanings of language units in question
- Discovering new terms for creating and updating the medical knowledge base of terminological profiles of diseases

The approach to digitalising the spiral model is to use three media of different nature (Fig. 2):

- The mental medium includes concepts as parts of tacit knowledge in the minds of people
- The informational medium includes explicit knowledge as perceptual forms of concepts which are the parts of texts, diagrams, formulae, tables, etc.
- The digital medium encompasses digital potential sources of new knowledge, computer codes of concepts and their perceptual forms in networks, databases, etc.

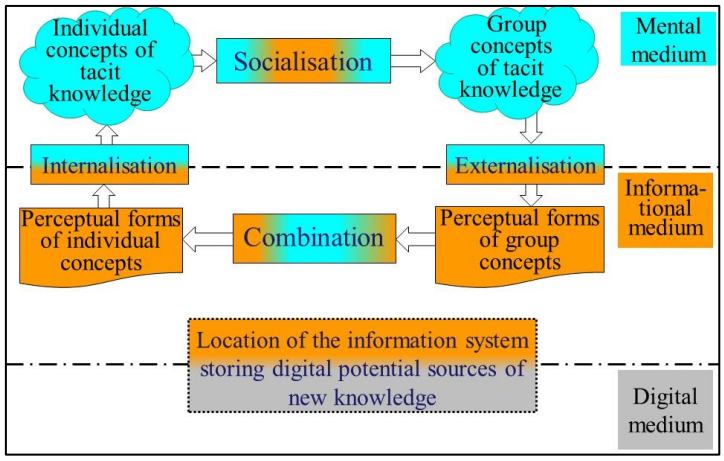

Figure 2. The spiral model processes and the location of the information system

According to the first two stages of the spiral model digitalisation described in (Zatsman and Khakimova, 2021), we distribute the four types of knowledge of the spiral model among two media: concepts of tacit knowledge are in the mental medium, and explicit knowledge as perceptual forms of concepts is in the informational medium (Fig. 2).

Note that the processes of socialisation and combination embrace the types of knowledge of both media, but to simplify Fig. 2, we will place these processes in different media. Such placement of these processes in media corresponds to the initial and final stages of them: the initial and final stages of the socialisation process refer to the mental medium, and the initial and final stages of the combination process refer to the informational medium. The processes of internalisation and externalisation begin and end in different media. Therefore, we place them on the boundary between them (Fig. 2).

As mentioned above the spiral model does not embrace any sources of new knowledge. To digitise the spiral model, the digital medium with the potential sources should be added to the mental and informational media. The main idea of the spiral model digitalisation is to aggregate the processes of the spiral model and the processes of the information system storing digital potential sources of new knowledge. For integrating the spiral model with the digital potential sources, we have added three processes of the information system: potential source retrieval, their visualisation, and interpretation (Fig. 3).

The task of the first process (retrieval) is to find potential sources of new knowledge that are necessary to achieve the goal of discovering new knowledge. For example, if the goal is to update the terminological profile of a certain disease with new terms, then the database of medical papers is searched for works

describing this disease and containing potentially new terms that are not in medical dictionaries and the current version of the terminological profile (Zatsman and Khakimova, 2021).

The task of the second process (visualization) is to convert the digital codes of the found potential sources into a sensory perceived form on the screen of an expert who performs the third process (potential source interpretation). The expert's task is to analyse potential sources of new knowledge and identify genuinely new sources from his individual point of view. In the above example of updating the terminological profile, the expert analyses potential new terms and their contexts in the found papers and divides the genuinely new terms and new synonyms of the terms which were already presented in the terminological profile of a disease. Such division of potentially new terms reflects the individual point of view of only this expert. Individual new terms and synonyms are added to the terminological profile by the combination process (Zatsman and Khakimova, 2021).

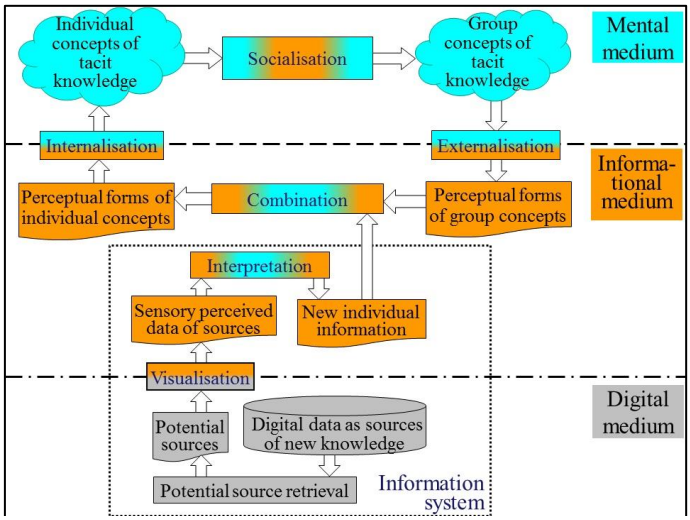

Figure 3. The spiral model aggregated with the digital potential sources and processes of the information system

When performing the combination process, in the general case, individual information is aggregated with group information (as perceptual forms of group concepts). The input of the process of internalisation is individual information (as perceptual forms of the expert's individual concepts) in the context of the already obtained group information. Then the processes of socialisation and externalisation are carried out according to the spiral model, perceptual forms of

new and/or updated group concepts are generated, and the next cycle begins with the process of potential source retrieval in the information system. The time points of creation of new individual information are fixed in the system.

2.3 Encoding knowledge dynamics

Aggregating the processes of the spiral model and the processes of the information system makes it possible to implement three functions: to fix the time points of generation of new (updated) group information, encode knowledge dynamics and mark during the decision-making process exactly the new knowledge that was used in each specific case. To implement these three functions, we add to the information system two knowledge bases for representing new knowledge in the digital medium, as well as the following processes of encoding (Fig. 4):

- Individual concepts and their forms
- Group concepts and their forms
- Knowledge dynamics

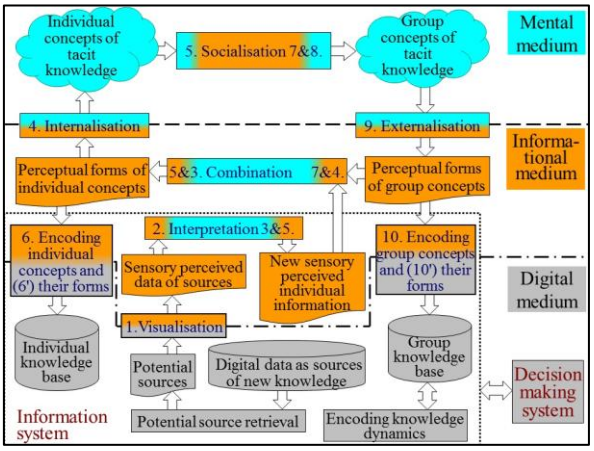

Figure 4. The model of knowledge creation (MKC)

Thus, retrieval, visualisation, interpretation and encoding processes, which are executed by the information system, are added to the four processes of the spiral model. Some processes include one or more numbered transformation stages, which will be described below. The outcomes of encoding concepts and their representation forms are stored in two knowledge bases.

The base of individual knowledge stores a description of new concepts of individual knowledge created and described by an expert, as well as the time

points of their entry into this knowledge base. The group knowledge base stores a description of new or updated concepts of group knowledge, agreed upon and described by the team of experts, as well as the time points of their entry into this knowledge base.

Fixing these time points by the information system makes it possible to see the dynamics of growth, the processes of socialisation and change of new knowledge (Zatsman, 2020), as well as to link the decision made to the knowledge used and mark its sources. To link the decision made to that knowledge, it is necessary to integrate the information system with a decision-making system. In this case, it will be possible to store the history of the decisions made, linked to the used knowledge generated according to the MKC, and its sources.

3 Evolving the DIKW hierarchy

3.1 Previous framework of the DIKW hierarchy

In 1989, Russell Ackoff introduced the notion of "DIKW hierarchy" (data, information, knowledge, wisdom) and described the linkages between them as follows:

"Wisdom is located at the top of a hierarchy of types, types of content of the human mind. Descending from wisdom there are understanding, knowledge, information, and, at the bottom, data. Each of these includes the categories that fall below it — for example, there can be no wisdom without understanding and no understanding without knowledge" (Ackoff, 1989).

Note that when using the DIKW hierarchy, only four of its levels (data, information, knowledge, wisdom) are often considered, and a separate level is not singled out for understanding (Rowley, 2007). Sometimes they confine themselves to considering the first three terms – data, information, knowledge – and describing linkages between them (Chen et al., 2009).

When Ackoff says that higher terms include lower ones, he is talking about the processes of their transformation, and not about the inclusion of their semantic content, which is described by subsumption relations or other hierarchical relationships. Jennifer Rowley draws attention to this feature of the description of the DIKW hierarchy in the review of works devoted to the DIKW hierarchy. According to Rowley (2007, p. 163), the DIKW hierarchy "is one of the fundamental, widely recognized and 'taken-for-granted' models in the information and knowledge literatures". The main conclusion of her scrutiny of the literatures is that:

"Typically information is defined in terms of data, knowledge in terms of information, and wisdom in terms of knowledge, but there is less consensus in the description of the processes that transform elements lower in the hierarchy into those above them, *leading to a lack of definitional clarity* (italics supplied)".

The need for more definitional clarity is due to the fact that the same word can have several meanings (for example, information) and sometimes denotes entities having mutually exclusive properties (Newman, 2001). Thus, it is proposed that different meanings are expressed lexically when describing the processes of knowledge creation and encoding of its dynamics in time points of when new concepts appear or existing concepts change. The Fig. 4 distinguishes between sensory perceived (informational medium) and digital information (digital medium), sensory perceived and digital data as sources of new knowledge (digital medium), knowledge, concepts (mental medium) and their digital representations in knowledge bases (digital medium).

3.2 Evolving the DIKW hierarchy based on MKC processes

The MKC uses different meanings of the first three notions of the DIKW hierarchy (data, information, knowledge), leading to further definitional clarity. As a theoretical basis for constructing the MKC, five articles were used that describe the spiral model and its variants (Nonaka, 1991; Nonaka and Takeuchi, 1995; Nissen, 2006; Wierzbicki and Nakamori, 2006; Wierzbicki and Nakamori, 2007). The fundamental novelty of the MKC is that it includes digital sources of new knowledge, which should correspond to the goal of generating new knowledge.

The first principle of constructing the MKC is to employ three media of different nature: mental, informational, and digital ones (Fig. 2-4). The second principle of constructing the MKC is to embrace digital sources of new knowledge which are visualised, interpreted and combined with perceptual forms of group concepts (Fig. 4). In other words, the combination process has two inputs in each spiral turn: new sensory perceived individual information as the output of the interpretation process and perceptual forms of group concepts as the output of the externalisation process.

The MKC processes can consist of one, four, five or six transformation stages. Five processes (visualisation, encoding individual concepts, internalisation, externalisation, and encoding group concepts) include one stage of transformation with numbers 1, 4, 6, 9 and 10, respectively. The socialisation process has four stages (5, 12, 7, 8 in Fig. 5; the stage 12 is not shown in Fig. 4). The interpretation process has five stages (2, 11, 14, 3, 5 in Fig. 5; the stages 11

and 14 are not shown in Fig. 4). The combination process has six stages (4, 7, 13, 15, 3, 5 in Fig. 5; the stages 13 and 15 are not shown in Fig. 4).

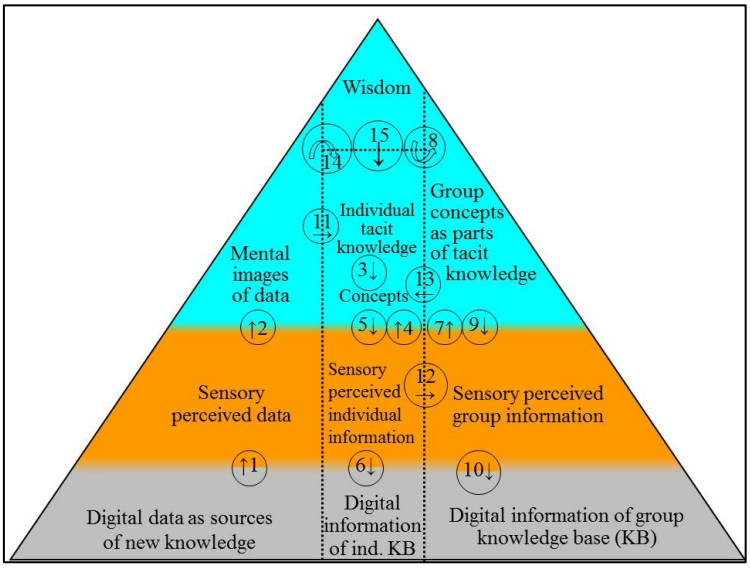

Figure 5. The medium version of the DIKW hierarchy

These 15 stages became the basis for the creation of the medium version of the DIKW hierarchy (Fig. 5), which describes the mutual transformations between sensory perceived and digital data, sensory perceived and digital information, individual/group concepts, knowledge, and wisdom. The use of MKC processes' stages in the DIKW hierarchy that transforms entities located in three media, on the one hand, complicates the DIKW hierarchy, on the other hand, leads to greater clarity on processes that transform entities of the DIKW hierarchy (the lack of clarity was noted by Jennifer Rowley (2007)). Let us briefly describe the stages numbered from 1 to 15.

1. Visualization is the stage of converting digital data into sensory perceived data performed by a computer (in general, it can be performed in both directions).

2. Creating the mental images of sensory perceived data by a person is the first of five stages of the interpretation process.

3. The division of individual tacit knowledge into concepts using a sign system is the fourth of the five stages of the interpretation process of sensory perceived data (see below the second, third, and fifth stages under numbers 11, 14, and 5), and the fifth of the six stages of the combination process.

4. Internalisation is the spiral model process (Nonaka, 1991; Nonaka and Takeuchi, 1995), and the first of six stages of the combination process.

5. Representing individual concepts of tacit knowledge in sensory perceived forms (i. e. individual information) is the last of the five stages of the interpretation process, the first of four stages of the socialisation process, and the last of the six stages of the combination process.

6. Encoding sensory perceived individual information is the process of their representation by computer codes in the digital medium.

6'. Encoding individual concepts of tacit knowledge is the process of their representation by computer codes in the digital medium.

7. Creating group concepts is the second of six stages of the combination process (see below the third and fourth stages under numbers 13 and 15), and the third of four stages of the socialisation process.

8 (optional). Refining group concepts of tacit knowledge based on previous persons' experience of coordinating their individual concepts is the last of the four stages of the socialisation process (see below the second stage under number 12).

9. Externalisation is the spiral model process, i. e. representing group concepts of tacit knowledge in sensory perceived forms (i. e. group information).

10. Encoding sensory perceived group information is the process of their representation by computer codes in the digital medium.

10'. Encoding group concepts of tacit knowledge is the process of their representation by computer codes in the digital medium.

11. Interpreting mental images of sensory-perceived data by a person is the second of five stages of the interpretation process.

12. Generating sensory perceived forms of group concepts based on sensory perceived forms of individual concepts is the second of four stages of the socialisation process.

13. Creating individual concepts based on group concepts as parts of tacit knowledge is the third of six stages of the combination process.

14 (optional). Refining individual concepts of tacit knowledge based on previous person's experience of interpreting mental images of sensory perceived data.

15 (optional). Refining individual concepts of tacit knowledge based on previous persons' experience of joining outcomes of stages 4 and 13.

During the creation of the medium version of the DIKW hierarchy, the transformation stages from the MKC were used. At the same time, in order not to

complicate Fig. 5, it does not show the stages of encoding individual and group concepts, which are labelled 6' and 10' in Fig. 4. Previously, the paper (Zatsman, 2019) showed that stages 6' and 10' can be implemented technologically if stage 6' is aggregated with stage 6, and stage 10' with stage 10. The medium version, which reflects the aggregation of these stages, is shown in Fig. 6 (in order to show aggregation, we swapped around data and individual information).

One more stage 16 is also added for dividing group knowledge into concepts, similar to stage number 3. It makes the proposed medium version of the DIKW hierarchy more universal (other stages are not shown in Fig. 6).

4 Conclusions

There are four main differences between the MKC and the spiral model (Nonaka, 1991; Nonaka and Takeuchi, 1995). First, the MKC distinguishes between two representation ways of knowledge: by sensory perceived information, e.g. words (see the interpretation and externalisation processes in Fig. 4) and by computer codes (see encoding concepts and their forms). Second, the MKC processes can include transformation stages. Third, the MKC includes digital potential sources of new knowledge, which should correspond to the goal of generating new knowledge. And finally, aggregating the processes of the spiral model and the processes of the information system makes it possible to encode knowledge dynamics and mark during the decision-making process exactly the new knowledge that was used in each specific case.

The MKC is the foundation of evolving previous version of the DIKW hierarchy because its processes and their stages establish linkages between data, information, knowledge, and wisdom. The use of MKC processes' stages that transform entities located in three media leads to greater clarity on processes that transform entities of the DIKW hierarchy. The medium version of the DIKW hierarchy (Fig. 5) reveals the spectrum of the stages that need to be implemented in information technology of discovering new knowledge in digital sources (Fig. 4 shows far from all the processes' stages).

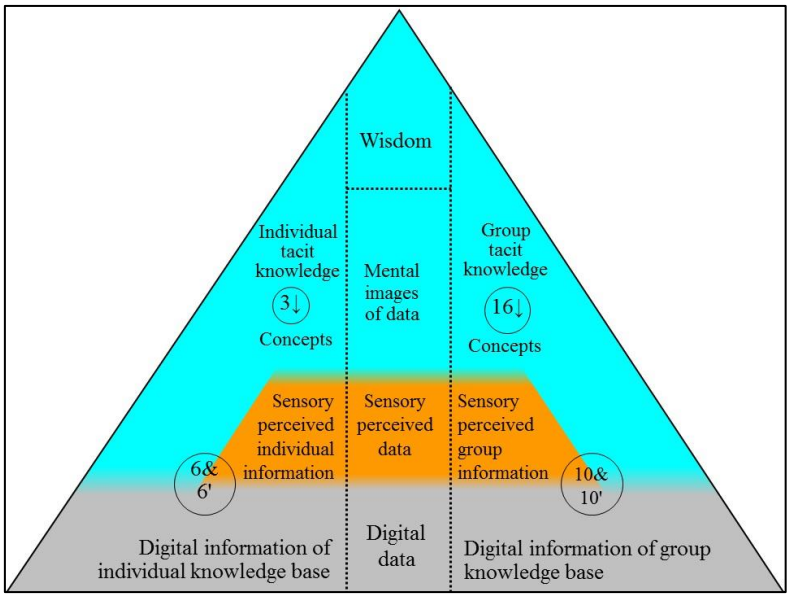

Figure 6. The medium version of the DIKW hierarchy: encoding concepts as parts of tacit knowledge

Previously, particular cases of the MKC were created, which were used in the development of information technologies for the goal-oriented discovery of new linguistic and medical terminological knowledge in scientific documents (Zatsman, 2021; Zatsman and Khakimova, 2021; Zatsman et al., 2022), but without usage of new knowledge in decision-making systems. Having completed the work on the creation of the MKC, we plan to integrate the processes of discovery, socialisation of new knowledge and decision-making processes within the corporate information medical system.

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Sustainable Intellectual Capital: Characteristics and Lines of Research

Javier Martínez-Falcó

Department of Business Management
University of Alicante
Campus de San Vicente del Raspeig, s/n
03690 San Vicente del Raspeig, Spain

Bartolomé Marco-Lajara

Department of Business Management
University of Alicante
Campus de San Vicente del Raspeig, s/n
03690 San Vicente del Raspeig, Spain

Patrocinio Zaragoza-Sáez*

Department of Business Management
University of Alicante
Campus de San Vicente del Raspeig, s/n
03690 San Vicente del Raspeig, Spain

Mercedes Úbeda-García

Department of Business Management
University of Alicante
Campus de San Vicente del Raspeig, s/n
03690 San Vicente del Raspeig, Spain

** Corresponding author*

Abstract

Organizations have become aware of the need to expand their objectives beyond traditional economic issues. Thus, since the concepts of Corporate Social Responsibility (CSR) and Corporate Sustainability (CS) were introduced, more and more managers introduce social and environmental objectives in their decision-making process. Additionally, organizations focus their efforts on the development of their intangible assets to achieve better performance, since these guarantee their survival, value creation and improvement of competitive advantage. The set of intangible assets that an organization possesses constitutes its Intellectual Capital (IC).

The existing literature has repeatedly illustrated different concepts and dimensions of IC from various perspectives. However, the terms "green", "social" and "sustainable" IC have recently been incorporated into the academic literature on the management of companies' social and environmental responsibility, representing the fusion between two key aspects for the future success of organizations: (1) the management of intangibles and (2) sustainability.
In order to increase the knowledge in the field of intangibles management from the perspective of sustainability, the purpose of this work is to carry out a systematic review of the scientific literature around a very new topic: Sustainable Intellectual Capital (SIC). The research questions that arise are: (1) How has the scientific production on the SIC evolved? and (2) What are the fundamental characteristics of this type of study?
To answer the research questions formulated, a systematic review of the literature was carried out according to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses methodology (PRISMA, 2022).
Data collection was carried out between January and July 2021 through the Web of Science and Scopus databases. After eliminating duplicate papers and those that did not coincide with the topics of interest, the final sample consisted of 32 articles.
The results obtained shed light on the following aspects: (1) 71.87% of the papers on the SIC have been carried out in the years 2019, 2020 and 2021; (2) The scientific production analysed has been divided into eight blocks: the relationship between the green management of human resources and Green Intellectual Capital (GIC), the relationship between the GIC and green innovation, the conceptualization and analysis of the SIC construct, the link between logistics and management of the green supply chain with the GIC, the effect of organizational environmental awareness and environmental regulations on the GIC, the effect of the GIC on the competitive advantage of the organizations, the impact of the GIC on the CS and the role of information and communication technologies and the GIC in the achievement of the CS; (3) The use of quantitative methodologies predominates over qualitative ones. In particular, the use of Structural Equation Modelling (SEM) stands out; (4) Most of the studies have focused on the analysis of companies in the secondary sector, more specifically, manufacturing firms.

Keywords – Sustainable intellectual capital, Triple bottom line, Green, Social and Economic intellectual capital, PRISMA methodology

Paper type – Academic Research Paper

1 Introduction

Organisations have become aware of the need to expand their objectives beyond traditional economic issues. Thus, since the concepts of Corporate Social Responsibility (CSR) and Corporate Sustainability (CS) were introduced, more and more managers introduce social and environmental objectives in their decision-making process (Bansal, 2005). Both concepts have as a common denominator the search for well-being in society and the environment through business activities.

Additionally, organisations focus their efforts on the development of their intangible assets to achieve better performance, since these guarantee their survival, value creation and improvement of competitive advantage (Khan, Yang and Waheed, 2019). The set of intangible assets that an organisation possesses constitutes its Intellectual Capital (IC), so companies with a richer and more sophisticated IC can obtain greater advantages than those with a poor IC (Ahmad and Ahmed, 2016).

The existing literature has repeatedly illustrated different concepts and dimensions of IC from various perspectives. However, the terms "green", "social" and "sustainable" IC have recently been incorporated into the academic literature on the management of companies' social and environmental responsibility, representing the fusion between two key aspects for the future success of organisations: (1) the management of intangibles and (2) sustainability.

In order to increase the knowledge in the field of intangibles management from the perspective of sustainability, the purpose of this work is to carry out a systematic review of the scientific literature around a very new topic: Sustainable Intellectual Capital (SIC). The research questions that arise are: (1) How has the scientific production on the SIC evolved? and (2) What are the fundamental characteristics of this type of studies?

The structure of the paper is as follows: after the "Introduction", a literature review of the terms CSR, CS and SIC is carried out. The methodology to be used and the data collection procedure are described below. Subsequently, findings and their discussion are shown. Finally, the main conclusions, contributions and future lines of research derived from the study are presented.

2 Literature review

2.1 Corporate Social Responsibility (CSR)

Since the 1950s, various definitions have been proposed around the concept of CSR, both by academics and by national and international institutions and, although there is no consensus on its definition, there are some common characteristics in all of them.

First, CSR is voluntarily applied by companies (Eilbert and Parket, 1973; Jones, 1980; Van Marrewijk, 2003; CSR Observatory, 2014; Sarkar and Searcy, 2016), which links it to the idea of going beyond strict compliance with legal requirements raised by Waldam et al. (2006) and the Forum of Experts in Corporate Social Responsibility (2007).

Second, while Walton (1967), Van Marrewijk (2003), Hopkins (2004) and the European Commission (2011) show the close relationship that the company must maintain with their stakeholders, David and Blosmstrom (1966) and Waldman et al. (2006) focus on meeting the needs and expectations of the different stakeholders.

Third, several authors highlight that CSR's actions transcend the economic interests of the organisation (Davis, 1960; Davis and Bomstrom, 1966; Eells and Walton, 1974), since the underlying idea is to integrate social and environmental concerns into activities developed by it (European Commission, 2001; Van Marrewijk, 2003; Ismail, 2009; Aguinis and Glavas, 2012; CSR Observatory, 2014).

Fourth, another common characteristic refers to the responsibility of organisations to mitigate the negative externalities generated by their activity (Fitch, 1976; Mohr, Webb and Harris, 2001; Forum of Experts on Social Responsibility, 2007; European Commission, 2011; CSR Observatory, 2014).

2.2 Corporate Sustainability (CS)

The concept of sustainability firstly became known globally through the report *Our Common Future* of the World Commission on the Environment, known as the *Brundtland Commission*. This commission related sustainability to environmental integrity, social equity and economic prosperity, coining the term sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p.43).

According to Schwartz and Carroll (2008), originally CS was considered solely from an environmental point of view and social aspects were gradually incorporated. Agenda 21, approved at the United Nations Conference on Environment and Development (UNCED) in 1992, can be considered a milestone in such incorporation (Steurer et al., 2005), since in Agenda 21 addressed both social and environmental variables, even though most member countries had a biased view of the concept towards purely environmental issues (Giddings, Hopwood and O'brien, 2002). Under this approach, Doyle (1998) argued that social issues should be a priority in thinking about CS. Similarly, the concept of sustainability developed by Gladwin, Kennelly and Krause (1995) also focused on social aspects, defining CS as "a process to achieve human development in an inclusive, connected, equitable, prudent and safe way" (p. 878).

Later, the economic dimension was introduced. However, it did not reach its maturity until Elkington (1999) introduced the concept of the Triple Bottom Line

(TBL). According to this author, sustainable development implied the simultaneous search for economic prosperity, environmental quality and social equity. Therefore, organisations pursuing CS need to act not only based on financial results, but also on environmental and social results.

However, there is some ambiguity in the literature as to whether CS should be a three-dimensional (economic, social and environmental), two-dimensional (social and environmental) construct or a synonym for environmental management.

2.3 Sustainable Intellectual Capital (SIC)

In the knowledge society, organisations focus their efforts on developing their intangible assets to achieve better performance (Agostini, Nosella and Filippini, 2017), since these guarantee the survival of an organisation (Obeng, Robson and Haugh, 2014), they foster value creation (Edvinsson and Malone, 1997; Berezinets, Garanina and Ilina, 2016) and enhance their competitive advantage (Khan, Yang, and Waheed, 2019). As stated in the "Introduction" section, the intangibles of an organisation constitute its IC (Alcaniz, Gomez-Bezares and Roslender, 2011).

The integration of IC with sustainability is rare and both academics and practitioners have paid little attention to this relationship. Faced with this situation, the IC "green", "social" and "sustainable" terms have recently been incorporated into the academic literature on the management of social and environmental responsibility. Under the TBL approach, it is possible to affirm that the term Green Intellectual Capital (GIC) focuses on environmental issues (Chen, 2008; López-Gamero et al., 2009), the term Social and Environmental IC focuses on social and environmental issues, the Social and Economic IC focuses on social and economic aspects and the SIC on environmental, social and economic issues (Zaragoza-Sáez et al., 2020).

Chen (2008) first introduced the concept of GIC, defining it as "the total stock of all kinds of intangible assets, knowledge, capabilities and relationships, etc. about environmental protection or green innovation at the individual level and the level of the organisation within a company" (p. 277). Nikolaou (2019) introduced the concept of social and environmental IC to address the sustainable intangibles of the company not only from an environmental point of view, but also from a social point of view. However, despite incorporating the social dimension of CS, it does not introduce a holistic vision of it.

With the aim of combining economic, social and environmental perspectives, Zaragoza-Sáez et al. (2020) introduced the SIC construct in the academic

literature, defining it as "the set of human, structural and relational intangibles that a company can take advantage of to carry out economic, social and environmental management, which allows it to achieve competitive advantages" (p. 4). Thus, in keeping with the TBL approach, the authors break down the SIC into two dimensions: GIC and Social and Economic IC (SEIC). On the one hand, as already explained, the GIC is made up of intangible human, structural and relational capital linked to the conservation and management of natural resources. On the other hand, SEIC is made up of the intangible human, structural and relational capital linked to the impact that the company has on the social system in which it operates and to the generation of wealth through its economic activity. The definition provided by Zaragoza-Sáez et al. (2020) surpasses the previous conceptualisations, to the extent that it provides a broader and more complete vision of the concept.

After reviewing the literature and given the novelty of the SIC topic, two research questions arise: How has scientific production on SIC evolved in recent years? and (2) What are the fundamental characteristics of this type of studies?

3 Methodology

To answer the research questions formulated, a systematic review of the literature was conducted according to the Preferred Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines between January and July 2021. This methodology is based on a 27-criteria checklist and a four-step flowchart that aim to improve the quality of systematic review protocols by providing authors with a roadmap for conducting systematic reviews (Moher et al., 2015).

The motivation of this research is based on two basic premises. Firstly, the development and dissemination of the SIC allows the company to identify to what extent it has accepted environmental responsibility for the impacts caused by its activity. Secondly, the SIC facilitates the realisation of sustainable activities thanks to the knowledge acquired.

3.1 Data collection

Data collection was carried out between January and July 2021 through the Web of Science and Scopus databases. The articles analysed in this review were selected based on the following two criteria: (1) articles in scientific journals and (2) published between 2008 and 2021. On the one hand, only scientific articles were included since publications in scientific journals they are, compared to other

forms of communication, certified knowledge (Callon, Courtial and Penan, 1993). On the other hand, the year 2008 was chosen as the starting year because it was when Chen (2008), through his seminal article, introduced the GIC construct, giving rise to a new field of research within the academic literature on IC. Once the search was carried out, the studies were filtered according to the category of Management and only the papers written in English were selected. The search equation applied was the following:

(["green intellectual capital" OR ("green human capital" OR "green structural capital" OR "green relational capital")] OR ["sustainable intellectual capital" OR ("sustainable human capital" OR "sustainable structural capital" OR "sustainable relational capital")] OR ["environmental intellectual capital" OR ("environmental human capital" OR "environmental structural capital" OR "environmental relational capital")] OR ["social intellectual capital" OR ("social human capital" OR "social structural capital" OR "social relational capital")] OR ["social intellectual capital" OR ("social human capital" OR "social structural capital" OR "social relational capital")] OR ["social and environmental intellectual capital" OR ("social and environmental human capital" OR "social and environmental structural capital" OR "social and environmental relational capital")] OR ["social and environmental intellectual capital" OR ("social and environmental human capital" OR "social and environmental structural capital" OR "social and environmental relational capital")] OR ["social and economic intellectual capital" OR ("social and economic human capital" OR "social and economic structural capital" OR "social and economic relational capital")])

A total of 110 papers were obtained from the search. After eliminating duplicate articles and those that did not coincide with the study topics, the final sample consisted of 32 papers.

4 Findings

From the papers selected for the systematic review and based on four criteria (main objective of the study, methodology used, industry and field of the activity) the results are shown in Table 1.

Table 1. Scientific production on SIC (2008-2021)

Author(s)	Fundamental information	Methodology/Method	Industry / Country	Variable
Chen (2008)	GIC construct is proposed and results show that it has a positive and significant effect on the competitive advantage of firms.	Quantitative / ANOVA	Electronic Industry / Taiwan	GIC
López-Gamero et al. (2011)	Importance of Green Human Capital (GHC), Green Structural Capital (GSC) and Green Relational Capital (GRC) in the accumulation and use of ecological knowledge.	Qualitative / Multiple case study	Several industries / Spain	GIC
Huang and Kung (2011)	Environmental awareness has an indirect impact on competitive advantage through GIC investment.	Quantitative / Structural Equation Modelling (SEM)	Manufacturing sector / Taiwan	GIC
Baresel-Bofinger et al. (2011)	Knowledge Management (KM) and GIC improve the quality of organic knowledge and are important for the application of organic supply chain management practices.	Qualitative / Multiple case study	Several industries / Greece	GIC
Chang and Chen (2012)	CSR and environmental awareness have positive effects on GIC. In addition, environmental awareness mediates the relationship between CSR and GIC.	Quantitative / SEM	Manufacturing sector / Taiwan	GIC
Chen and Chang (2013)	Corporate environmental ethics have a positive effect on the results of the GHC, GRC and Green Innovation (GI).	Quantitative / SEM	Manufacturing sector / Taiwan	GHC GRC
Delgado-Verde et al. (2014)	The GIC has an indirect impact on the GI through the GSC.	Quantitative / SEM	Manufacturing sector / Spain	GIC
Chang (2016)	The environmental commitment of the companies influences positively and directly on GI and indirectly through the Green Adaptative Ability (GAA). However, GHC does not directly affect GI results, but indirectly through GAA.	Quantitative / SEM	Manufacturing sector / Taiwan	GHC
Jirawuttinunt (2018)	Green Human Resources Management (GHRM) practices have a positive impact on GIC. Companies can accelerate GHRM to improve GIC and gain competitive advantage.	Quantitative / Regression analysis	Several industries / Thailand	GIC
Xu (2019)	GHC and GSC influence GHRM.	Quantitative / SEM	Manufacturing sector / China	GIC
Yong et al. (2019a)	GHC and GSC influence GHRM. However, GHC is not significantly related to GHRM.	Quantitative / SEM	Manufacturing sector / Malaysia	GIC
Yusoff et al. (2019)	Of the three dimensions that make up the GIC, only the GSC and the GRC have a positive and significant relationship with the CS.	Quantitative / SEM	Manufacturing sector / Malaysia	GIC

Bag and Gupta (2019)	The availability of GHC positively influences the adoption of reverse logistics and the performance of manufacturing operations.	Quantitative / SEM	Automotive industry / South Africa	GHC
Nikolaou (2019)	Theoretical framework under the approach based on corporate knowledge and IC to explain the interrelationship between some mediating components of the environmental and financial results of companies.	Qualitative / Narrative review of the literature	N/A	N/A
Yong et al. (2019b)	The four key factors influencing GHRM adoption are stakeholder pressures, relative advantage, top management commitment, and GIC.	Qualitative / Case study	Manufacturing sector / Malaysia	GIC
Yusliza et al. (2020)	There is a positive influence of the GIC on economic, environmental and social performance.	Quantitative / SEM	Manufacturing sector / Malaysia	GIC
Malik et al. (2020)	Both GHRM and GIC practices have a positive effect on CS.	Quantitative / SEM	Manufacturing sector / Pakistan	GIC
Song, Yu, and Xu (2020)	The GHRM positively influences the GI, and the GHC mediates the link between both variables.	Quantitative / Regression analysis	Several industries / China	GHC
Zaragoza-Sáez et al. (2020)	Findings do not support the hypothesis that the SIC directly influences the performance of hotels. However, it is confirmed that CSR and KM mediate the above relationship.	Quantitative / SEM	Hotel industry / Spain	SIC
Shoaib et al. (2021)	A positive and significant effect is observed between GHRM and organisational commitment. In addition, the GHC mediates the effect between both variables.	Quantitative / SEM	Food industry / Pakistan	GHC
Ma, Chen and Ruangkanjanases (2021)	This study examines the determinants of GHC and job satisfaction. Only kindness and openness have a positive and significant impact on the GHC.	Quantitative / SEM	Several industries / China	GHC
Mansoor, Jahan and Riaz (2021)	There is a mediating effect of GHRM on the relationship between GHC and environmental performance. In addition, two dimensions of the GIC (GHC and GSC) are positively related to environmental performance.	Quantitative / SEM	Manufacturing sector / Pakistan	GIC
Amores-Salvadó et al. (2021)	The role of the GSC is diverse and depends on the manifestation of the GSC analysed.	Quantitative / Regression analysis	Manufacturing sector / Spain	GSC
Ullah et al. (2021)	There is a positive and significant effect of GIC on CS. In addition, the moderating role of ICT between the GIC and CS is observed.	Quantitative / SEM	Manufacturing sector / China	GIC

Rehman et al. (2021)	Findings show that neither the GIC nor the GHRM are directly related to environmental performance. Instead, they show that GI mediates the relationships between GIC, GHRM, and environmental performance.	Quantitative / SEM	Manufacturing sector / Malaysia	GIC
Trevlopoulos et al. (2021)	There are positive relationships between environmental results and the level of compliance with environmental legislation by companies, as well as between companies' GI and environmental results.	Quantitative / SEM	Metallurgical industry / Several countries	GIC
Ali et al. (2021)	The GHC and GSC significantly increase GI adoption. However, the GRC does not have a significant impact on the GI.	Quantitative / Regression analysis	Manufacturing sector / Pakistan	GIC
Albertini (2021)	The managers of the main European companies develop ecological associations to face the challenge of the energy transition by modifying their manufacturing processes and improving their SIC.	Qualitative / Analysis of the lexical and thematic content of the letters.	Several industries / Seveal countries	SIC
Wang and Juo (2021)	The three constructs of the GIC positively affect economic performance, ecological performance and GI, respectively.	Quantitative / SEM	Tech sector/ Taiwan	GIC
Agyabeng-Mensah and Tang (2021)	GHC has significant influence on financial results. However, it does not have a significant influence on social performance and green competitiveness.	Quantitative / SEM	Manufacturing sector / Ghana	GHC
Jirakraisiri, Badir and Frank (2021)	The green strategic intention of a company has positive effects on the three dimensions of the GIC. In turn, the three dimensions have positive effects on GI.	Quantitative / SEM	Several industries /Thailand	GIC
Shah et al. (2021)	There is a significant association between GHC and GRC with environmental performance. Likewise, a strong association between responsibility and environmental performance is demonstrated.	Quantitative / SEM	Hospital industry	GIC

Source: elaborated by the authors

5 Discussion

The discussion of the results is shown below, depending on the objective of the study, the methodology used and the sector of activity analysed:

5.1 According to the main objective of the study

It is possible to identify the following topics and relationships:

- First, 9 papers address the *relationship between the GHRM and the GIC*. Three of them analyse the effect of the GIC on the GHRM and point out the existence of a positive relationship between both variables. However, there are differences when it comes to identifying which dimension of the SIC affects GHRM (Xu, 2019; Yong et al., 2019a, 2019b). Jirawuttinunt (2018) analyses the opposite relationship, considering the GHRM as the driver of the GIC and identifying a positive and significant relationship between both variables. Malik et al. (2020) demonstrates a positive effect of GIC and GHRM in CS. Three other works contemplate the GIC and the GHRM as mediating variables in the proposed models. While Song et al. (2020) and Shoaib et al. (2021) consider that the GHC mediates the GHRM-GI relationship and the GHRM-organisational commitment, respectively, Mansoor et al. (2021) identify the GHRM as a mediating variable between the GIC and environmental performance. The remaining work examines the GHC determinants that facilitate the GHRM process (Ma et al., 2021).
- Second, 7 papers investigate the *relationship between GIC and GI*. Chen and Chang (2013), Delgado-Verde et al. (2014), Chang (2016), Ali et al. (2021) and Jirakraisiri et al. (2021) analyse the GI as a dependent variable, introducing the GIC as an independent or mediating variable in the proposed models. Chen and Chang (2013) demonstrate a positive and significant relationship between GHC and GI performance. Instead, Chang (2016) states that GHC does not directly affect GI, but indirectly through GAA. Delgado-Verde et al. (2014) point out that the GIC has an indirect impact on the GI through the GSC. Ali et al. (2021) show that GHC and GSC increase significantly with GI adoption. Jirakraisiri et al. (2021) show that the three dimensions of the GIC positively and significantly influence the adoption of the GI. In the works of Wang and Juo (2021) and Rehman et al. (2021) do not analyse the GI as a dependent variable, but rather as a mediating variable in the relationship between the GIC and environmental performance.
- Third, 4 papers address the *concept of SIC*. Two of them, López-Gamero et al. (2011) and Albertini (2021) only refer to environmental aspects. Instead, Nikolaou (2019) creates and analyses the social and environmental intellectual capital construct, made up of social and environmental intangibles, and Zaragoza-Sáez et al. (2020) concentrate the three dimensions of the TBL in the IC.

- Fourth, 3 papers deal with *logistics and green management of the supply chain*. Baresel-Bofinger et al. (2011) demonstrate the existence of a positive relationship between the GIC and the implementation of green management practices in the supply chain. Bag and Gupta (2019) state that GHC is a critical element for reverse logistics adoption, and Agyabeng-Mensah and Tang (2021) find that green logistics practices mediate the relationship between GHC and green competitiveness.
- Fifth, 3 papers analyse the *effect of the organisation's environmental awareness and environmental regulations on the GIC*. Chang and Chen (2012) verify that environmental awareness mediates the effect between CSR and GIC. Shah et al. (2021) demonstrate the existence of an indirect effect between GIC and environmental performance through the mediating role of environmental responsibility. Trevlopoulos et al. (2021) demonstrate the existence of a positive effect between environmental regulations and the three dimensions of the GIC.
- Sixth, 2 papers analyse the *effect of the GIC on the competitive advantage of organisations*. Chen (2008) demonstrated the existence of a positive and significant relationship between the GIC and competitive advantage, while Huang and Kung (2011) demonstrated the mediating role of competitive advantage in the relationship between environmental awareness and GIC.
- Seventh, 2 papers address the *impact of GIC on CS*. Yusoff et al. (2019) find that only GSC and GRC positively and significantly influence CS, while Yusliza et al. (2020) demonstrate how the GIC positively affects economic, social and environmental performance.
- Eighth, 2 papers analyse the *role of ICT and GIC in achieving CS*. While Ullah et al. (2021) demonstrate the moderating role of ICT between the GIC and the CS, Amores-Salvadó et al. (2021) find that the impact of the green technological distance on the adoption of proactive sustainable strategies depends on the manifestation of the GIC in the organisation.

5.2 According to the methodology used

The existence of a greater number of studies that use quantitative methodologies (27) compared to qualitative ones (5) stands out. In relation to

quantitative methods, the use of SEM predominates in 81.5% of the cases. Other quantitative methods have been regression (14.8%) and ANOVA (3.7%). The software most used to process the data obtained in quantitative research is SmartPLS, used in 7 of the 22 studies, which shows the relevance of this tool in research on the SIC.

The multiple case method has been the qualitative methodology tool used in 3 of the 5 qualitative studies. The other two qualitative investigations have used the narrative review of the literature and the lexical and semantic analysis of letters.

5.3 According to the sector and field of activity

The predominance of papers focused on a single sector (24) is observed as opposed to several sectors (7). Of the 24 publications focused on a single sector, those from the secondary sector predominate (83.3%) compared to the tertiary (8.3%), with only one work on the primary sector. The industry with the greatest weight in the analysed sample is manufacturing, with a total of 17 publications.

The countries with the largest number of studies are Taiwan (6) and Malaysia (5), representing 31.25% of the studies. Regarding the countries of origin of the companies analysed, the investigations tend to focus more on one country (28) than on several (3). The relationship between the sector and the country deserves special attention, since the investigations focus on the idiosyncratic sectors of each country. Proof of this is the case of the electronics sector in Taiwan (Chen, 2008; Wang and Juo, 2021), the manufacturing sector in China (Ullah et al., 2021), or the hotel sector in Spain (Zaragoza-Sáez et al., 2020).

6 Conclusions

One of the first conclusions drawn from the systematic review of the literature is the notable increase in the number of publications that address the SIC in the last three years analysed, given that 71.87% of the research has been published in this period. This confirms the statement of Yong et al. (2019a), who consider that the SIC "has not emerged as an important field of study until recently". It is also noteworthy that, of the 32 articles, almost 47% were published by the publishers Emerald and Elsevier in one of the journals in their catalogue, among which stand out due to the number of contributions the *Journal of Intellectual Capital* and the *Journal of Cleaner Production*. These results could be of interest to researchers who are in the process of identifying potential journals for publication of their results.

Most of the studies have dealt with analysing the GIC, leaving the Social and Economic IC in the background. The importance of developing GIC is because it can not only lead to increased productivity, but it can also enable organisations to charge relatively high prices for green products, thus gaining a competitive advantage (Chen, 2008). However, companies have recognised the need to balance social responsibility and economic performance in their operations (Wang and Juo, 2021), so social and economic IC should continue to be addressed in the academic literature, integrating its study under a new organisational paradigm: *the vision of the firm based on SIC*, in which environmental, social and economic intangibles are considered.

The scientific production analysed has been divided into eight seccions which determine the future challenges of research around the SIC. Regarding the methodology, the existence of a greater number of studies that apply quantitative methodologies compared to qualitative ones stands out, constituting the SmartPLS software a relevant tool in research on the SIC. Regarding the sector and field of activity, the selected studies have focused on the analysis of companies in the secondary sector, more specifically manufacturing companies, despite not being the most intensive in knowledge. This can be explained by the interest aroused by this sector, given its ability to generate employment and wealth in the economy.

The systematic review carried out has three main implications for theory and practice. First, it provides a solid foundation for the study of SIC, integrating green, social and economic IC under the TBL approach. Second, the review offers a unique insight into the topic, since, to our knowledge, no previous work has conducted a literature review in this field. Finally, the eight commented blocks determine the current lines of research on the SIC, so that researchers can use this classification to know the current research fronts as well as future research challenges around the SIC, being therefore a fundamental guide both for experienced scholars in the field and for those who want to start their study.

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Organizational Innovation as an Enabler for the Emergence of a Non-Precompetitive Knowledge Ecosystem

Amel Attour

Université Côte d'Azur, CNRS, GREDEG
250 Avenue Albert Einstein
CS 10269 – F – 06905 Sophia- Antipolis Cedex

Loubna Echajari

Tech-CICO, LIST3N, Université de Technologie de Troyes
12 Rue Marie Curie, 10300 Troyes

Nicolas Remond*

Tech-CICO, LIST3N, Université de Technologie de Troyes
12 Rue Marie Curie, 10300 Troyes

* *Corresponding author*

Abstract

In this paper we conduct a qualitative case study on how knowledge management occurs within a regulated safety context that seeks to make its knowledge sustainable. Thus, organizations, which operate in this context, try jointly, to create, share and, above all, sustain this knowledge for a long time. The most effective way to meet their objectives is to redesign their inter-organizational architecture into a non-competitive knowledge ecosystem. The back and forth between the research field and the theory, led us to ask the following research question: how a regulated safety context should evolve into a non-pre-competitive knowledge ecosystem? To answer this research question, we adopted an organizational perspective, integrating knowledge management and organizational innovation streams. Our results show the emergence of a non-pre-competitive knowledge ecosystems where actors' interactions are strictly collaborative due to its main goal: sustainable and inter-organizational knowledge management. This emergence is enabled by internal and inter-organizational innovation, i.e., the development of a knowledge management process. Organizational innovation is articulated within the actors' own (intra-organizational) knowledge systems, but also through the knowledge flow that is exchanged at the inter-organizational level. To achieve this, ecosystem governance is ensured by a focal actor (through regulatory legitimacy) who assumes the role of orchestrator, to sustain the knowledge flow through coordination and collaboration of ecosystem members.

Keywords - Sustainable Knowledge, Knowledge Ecosystem, Non-precompetitive Ecosystem, Organizational Innovation, Regulated Safety

Paper type - Academic Research Paper

1 Introduction

Knowledge ecosystem has gained attention in the strategic, innovation and entrepreneurship management literature. The concept is mostly mobilized to study how a network of actors collaborates to create knowledge for value creation and exploration. Defined as a meta-organization, knowledge ecosystems are organized around joint knowledge search that can differ in terms of nature and target (Järvi et *al.,* 2018). Beyond the traditional question of what a knowledge ecosystem is, and how it differs from other ecosystems' type (Valkokari et *al.,* 2015; Cobben et *al.,* 2022), a focus has been on how a knowledge ecosystem transfers to a business ecosystem, how it enables the emergence of a business ecosystem or how it facilitates the development of entrepreneurial activities (Clarysse et *al.*, 2014; Attour and Lazaric, 2020). More recently, in line with Van der Borgh et al., (2012), the management literature sheds light on how knowledge ecosystems are organized (Jarvï et *al.,* 2018; Öberg and Lundberg, 2022); and how knowledge is created and shared for value creation within such type of ecosystems. Some of these works paid attention to specific knowledge ecosystem they conceptualized as patent ecosystems (Schillaci et *al.,* 2022). But, whatever the specificity of the knowledge ecosystems studied, they have a common characteristic: ecosystem members (such as universities, public research institutions, and for-profit firms) collaborate to create and share knowledge (to create value) in a pre-competitive context of innovation (Järvi et *al.,* 2018). That is because the ecosystem outputs collectively generated is innovation (Thomas and Autio, 2020).

Innovation in such ecosystems refers to outputs of innovative processes (i.e., products, services, processes, business models, and knowledge) as well as to the process itself. It occurs in pre-competitive setting, where actors' activities are far from downstream activities that seek to exploit and commercialize newly generated knowledge (Valkokari, 2015). Such setting is thus a pre-commercialization one (Järvi *et al.,* 2018). Collaboration is dominant at that stage. It remains however framed by the easily anticipated competitive tensions that will take over once the pre-commercialization phase is over. Most often technological,

product or service, innovation is indeed the ultimate goal sought by the actors of the knowledge ecosystem. Moreover, knowledge creation and share fostered by the precompetitive knowledge ecosystem is a catalyst for these innovations. In other words, pre-competitive knowledge ecosystems support innovation in its exploration stage through research activities involving the creation of new knowledge, recombination of existing knowledge and inventions to be applied to new products, technologies, and services (Järvi *et al.,* 2018).

This paper sheds light on the inverse relation: how innovation supports knowledge management. We identified such a relation by studying the case of a non-pre-competitive knowledge ecosystem, which are unstudied by the literature. We define a non-precompetitive knowledge ecosystem as the gathering of heterogeneous actors mobilized to create and manage sustainable knowledge. The output here is therefore not innovation, but the sustainability of knowledge. Innovation occurs however, but in an organizational setting. Organizational innovation deals with the creation of new knowledge related to innovative organizational methods, practices, and structures, in contrast to existing ones that were established to achieve the organization's goals (Birkinshaw *et al.,* 2008).

The aim of this paper is therefore to introduce the concept of non-pre-competitive knowledge ecosystems by understanding how it may emerge. To answer this research question, we adopted an organizational perspective, as suggested by Jarvï *et al.,* (2018). As section 1 of this paper presents it, we integrate two separate streams of research: knowledge management and organizational innovation. We furthermore believe this study is the first to consider the specific case of non-precompetitive knowledge ecosystems. For that purpose, we conduct an exploratory case study of a regulated safety context that seeks to make its knowledge sustainable, as section 3 details it. Our results show that, within this context, safety is a matter of life or death (Halgren *et al.*, 2018). Thus, organizations, which operate in this context, try jointly, to create, share and, above of all, sustain this knowledge for a long time. To this end, actors need to innovate their intra-organizational architecture by building first a knowledge management system within their own organization. As well as through the knowledge flow within a knowledge management community. We develop these results in section 4 and derive three theoretical contributions discussed in this section. We conclude that our case study revealed the significance of non-pre-competitive knowledge ecosystem, its main characteristics and highlighted its role in effective inter-organizational knowledge management. We provide

recommendations for organizations on how to effectively manage and utilize knowledge within this specific knowledge ecosystem.

2 Literature Review

Both, management literature and business communities recognize knowledge as a critical resource for organizations (Prahalad and Hamel, 1994; Nonaka, 1994). More precisely, knowledge is perceived as an enabler of innovation and a facilitator of the value proposition of a company. And, knowledge management (KM) is defined as the process of creating, using, sharing, storing, coordinating, recombining, and managing knowledge and information within an organization to achieve its objectives (Alavi and Leidner, 2001; Sambamurthy and Subramani, 2005). Those processes are described as a complex social process. When knowledge is held by several actors or is located outside the boundaries of a single organization, a knowledge exchange mechanism is required (Kogut and Zander, 1992, 1996; Nahapiet and Ghoshal, 1998). Such a mechanism relies on several elements, such as: the opportunity and capacity to exchange and combine knowledge, the anticipation of the value created, the motivation of the actors in this process, the social interaction between the different actors, a common understanding and the accumulated experience favoring knowledge transfer through common routines, culture and language (Kogut and Zander, 1993, 1996; Teece *et al.,* 1997). From there, KM is understood as a set of principles and practices that aims to improve collaborative and cooperative interactions that occur within a particular intra and inter organizational environment. Interactions between individuals, organizations and knowledge artefacts are the primary enablers of knowledge processes.

To understand knowledge management mechanisms and processes within and inter-organizational environment, some recent works examined and/or mobilized the concept of knowledge ecosystems (Van der Borgh *et al.,* 2012; Järvi *et al.,* 2018; Öberg and Lundberg, 2022; Cobben *et al.,* 2022). Knowledge processes and, particularly knowledge development and transfer, are studied as the objective goals of the ecosystem. Two reinforcing mechanisms for knowledge development in the knowledge ecosystem are identified: structure and openness (Öberg and Lundberg, 2022). Structure describes a linear knowledge transfer accomplished through the ecosystem members who need to develop their capabilities to generate knowledge, rather than to develop the content of knowledge. Openness describes how ecosystem members interact and achieve common or shared purposes, how knowledge is developed and, how ecosystem expands its

knowledge base through collaborations with parties outside its own boundaries (Van der Borgh *et al.,* 2012; Järvi *et al.,* 2018). Those collaborations are made by firms rather than by a focal actor playing the role of coordinator (orchestrator) or than a public institute such the one of university. Indeed, in this literature, knowledge ecosystems are defined as "*heterogenous set of knowledge-intensive companies and other participants [, such as universities, regional system networks, etc.], that depend on each other for their effectiveness and efficiency and as such need to be located in close proximity*" (Van der Borgh *et al.,* 2012, p. 151). From that view, knowledge ecosystems focus on the development, transfer and integration of knowledge among parties (Cobben *et al.,* 2022), in pre-competitive settings where the output of knowledge processes is innovation (Järvi *et al.,* 2018).

A distinction is furthermore made between pre-competitive knowledge ecosystems searching for a knowledge domain and those searching within an identified knowledge domain, respectively characterized as prefigurative and partial forms of organizing (Järvi *et al.,* 2018). While in prefigurative ecosystem elements of organizing are absent but sufficiently predictable to be introduced later; in partial organized ecosystem, regulation and monitoring are present. They structure the organization logic of the ecosystem, as they are in use for coordinating the participants and their knowledge creation activities. But, as observed by Järvi *et al.,* (2018), despite the identification of the two organizational logics, the variety of knowledge ecosystems involves different configurations of search processes, because of a movement of back and forth between the two types of searches (for and within a knowledge domain). While the authors explain this movement thanks to a problem-solution pairs mechanism in reference to Von Hippel and Von Krogh (2016), we assume that the organizational logic of a knowledge ecosystem is itself subject to innovation. We do here reference to organizational innovation defined as "*changes in the organization's structure and processes, administrative systems, knowledge used in performing the work of management, and managerial skills that enable an organization to function and succeed by using its resources effectively*" (Damanpour *et al.,* 2009, p. 655). Based upon this definition Fernandes Rodrigues Alves *et al.,* (2018) identified several activities they classified as organizational innovation, such as brand management, divisional structure, leadership development, decentralization, the balanced scorecard, intellectual capital measurement and Six Sigma. All these activities are however emblematic to a business logic of organizational innovation, where the objective goal is business performance and the firm's environmental context is

competitive. Once can here ask if organizational innovation matters in non-competitive environment. This paper addresses this gap by examining the case of the emergence of a non-precompetitive knowledge ecosystem.

3 Methodology

3.1. Research context: Kronos ecosystem

For the purpose of our research question, we conduct an exploratory case study of a regulated safety context, applying a thematic analysis method (Gehman *et al.,* 2018; Williams and Moser 2019). A qualitative approach is appropriate for exploring the characterizing observed phenomena (Yin, 2008). Due to confidentiality issues, we will refer to the studied case under the code name Kronos. Kronos is an ecosystem form by various organizations in the energy field. These include (see table 1): public industrial and commercial establishments (Alpha, Eos, Helios), multinational companies (Daedalus, Talos), public companies (Icarus), professional federations (Perseus), administrations (Atlas, Sisyphus), and public institutions (Orpheus). Evolving in a safety-regulated context, the main objective of Kronos is to establish a sustainable knowledge for safety-related activities. This safety purposes within the ecosystem will be driven by certain standards and regulations to achieve a common public objective which requires strong technical know-how. Contrarily to traditional knowledge ecosystem, this objective is thus not hampered by individual positioning strategies of the actors. There is no competition between actors neither in upstream nor in downstream phases of the ecosystem's life cycle (emergence and existence). This stress the need to understand how a non-pre-competitive ecosystem emerges.

3.2. Data collection

We collected primary and secondary data during a period of sixteen months (from 2021 to 2022). Primary data were collected from 42 semi-structured interviews we conducted with members of the studied regulated safety context (see Table 1). It represents approximately 60 hours of recording for 700 pages of transcripts. Primary data were extended with secondary data from multiple sources; archives (mainly internal documents and public ones representing approximately a total of 1300 pages), frequent interactions with field actors (including regular meetings and informal exchanges) and observations through participation in various events. Data collection and analysis were conducted

iteratively between field and theory (Suddaby, 2006; Eisenhardt *et al.*, 2016; Gehman *et al.*, 2018).

Semi-structured interviews were conducted to have access to the experience of the ecosystem's various actors (Langley and Meziani, 2020), in order to expand our understanding of the studied phenomenon. We progressively identified the relevant informants through various exchanges with field actors and preliminary interviews. The interview guide on which we based our data collection was gradually built around several themes identified as the study progresses (e.g., intra- and inter-organizational KM, ecosystem, dynamics of interactions and collaborations, KM process, organizational structure and architecture).

Table 1: Interviews

Organizations	**Typology**	**Number of interviews**	**Interviewees**
Alpha	Public industrial and commercial establishment	28	Knowledge manager (1), Knowledge engineer (2), Safety manager (5), Safety engineer (4), Scientific and technological manager (3), Scientific and technological engineer (3), Memory manager (1), Strategic manager (2), Engineer (4), Archivist (2)
Eos	Public industrial and commercial establishment	1	Knowledge manager (1), Knowledge engineer (1)
Helios	Public industrial and commercial establishment	3	Knowledge manager (1), Project manager (2)
Icarus	Public company	1	Project manager (1)
Talos	Multinational company	2	Project manager (1), HR manager (1)
Daedalus	Multinational company	2	Knowledge manager (2)
Atlas	Administration	2	Senior official (1), Archivist (2)
Sisyphus	Administration	1	Archivist (1)
Orpheus	Public institution	1	General archivist (1), Archivist (2)
Perseus	Professional federation	1	Project manager (1)
Total	3600 min (60h) / 700 pages of transcripts (400,000 words)		

3.3. Data analysis

In order to bring out different explanatory mechanisms, the main data (the interviews) were fully transcribed and analyzed in several stages with thematic

analysis method (using Nvivo software for qualitative data analysis) to gradually construct meaning (Williams and Moser, 2019). Following Gioia *et al.,* (2013) systematic approach to qualitative data analysis, several codes emerged inductively from the data (Gehman *et al.,* 2018).

Initially the analysis is conducted through an abstract process of open coding (Strauss and Corbin, 2003). Then, during the analysis process we categorized the different information directly from the field (at the 1st order level of informants). And we compared these different categories allowing themes to emerge that would allow us to begin to explain and understand the phenomenon under study (at the second-order level of theoretical themes) (Gioia, 2021). Finally, we organized and structured these emergent themes into global dimensions to be able to build and support our theorizing at a higher level of abstraction (Gioia *et al.,* 2013; Williams and Moser, 2019).

4 Results

Our results highlight that Kronos is a non-precompetitive knowledge ecosystem emerging from two specific contexts aiming to satisfy recent political regulations (4.1). This new knowledge ecosystem differs from traditional knowledge ecosystems in the conditions of its emergence. The non-precompetitive knowledge ecosystem Kronos emerges through organizational innovation materialized at the internal and external level. Organizational innovation takes the form of development of knowledge management systems. In the case Kronos, such development is operated at the internal (4.2) and the inter-organizational level (4.3).

4.1 The emergence of a new form of ecosystems

Kronos is in the process of emerging following three main pre-existing conditions: two context specificities, that are (i) safety context and (ii) non-pre-competitive context; and (iii) a focal actor able to orchestrate activities and KM processes generating sustainable knowledge.

4.1.1 A regulated safety context

Organizations involved in Kronos evolve in a context very constrained by regulations to ensure a long-term perspective of safety-activities (i.e., the activities and their objective are envisaged over a long period, corresponding to several decades). This objective is materialized by the ability of ecosystem members of Kronos to control and/or apply safety standards.

"There are management measures that guarantee long-term operation (…) What is important for us is that we have a device that is operational and that lasts over time." (#32)

Indeed, in this type of context, organizations are forced to demonstrate their ability to control security. For these purposes, they must provide written and formalized evidence. This evidence is subject to validation by regulatory bodies. Thus, the day-to-day operational procedures are not subject to the law of "chance". Every procedure must be authorized before being put in place. These validation and control processes between the operating organizations, on the one hand, and the organizations having the role of control, on the one hand, produce a huge number of interactions.

"[Ecosystem actors] have [safety] requirements, which are prescriptions of means, and they also have prescriptions of objectives. In fact, it's a mix, they have objectives to follow and, in some cases, for some particular things, means to follow as well. And so, that, we [public authorities] check all the time." (#32)

4.1.2 Non-pre-competitive context

Here there is no competitive logic between the actors. They are, as they describe it, in "*the same boat*". The survival of their business depends on their joint effort to collaborate and achieve the safety objective jointly. Due to the context and its specificities, actors of Kronos are interdependent, and they have predefined roles (see figure 1), and their main activities are contractually or legally defined.

"We all work together for a common goal and a common vision; beyond that we also have common projects." (#40)

Those activities materialize sustainable and inter-organizational knowledge flows within Kronos. Those activities are composed of complex and varied knowledge and know-how (including more than 50 domains of expertise), through several projects (sometimes over decades). It implies collaboration and coordination between Kronos actor which in turn generates inter-organizational knowledge share, combination, and creation. This collaboration and coordination mechanisms ensure the sustainability of shared, combined and created knowledge. The value proposition materialized by Kronos is thus the flow of sustainable and inter-organizational knowledge within the ecosystem. Such main goal of Kronos characterizes its non-pre-competitive context orchestrated by Alpha.

"Multilateral interactions are strongly driven by [Alpha], necessarily (…) globally, it is still pretty structured, with committees that exist, participants who are more or less designated, and all of this is driven by [Alpha] according to the challenges of the upcoming schedules (…) there is always this management by [Alpha] and this centralization by [Alpha]." (#37)

However, the inter-organizational knowledge flow within Kronos is composed of various knowledge typologies: scientific knowledge (required by R&D for innovation), technical knowledge (for the development and achievement of projects), practical knowledge (on the products and services provided), organizational knowledge (all the knowledge of the organizations and their members, required to perform the activities) and know-how (tacit knowledge of organizations' members). This implies interactions between actors, to align with the safety regulated system. Such alignment is enabled through a focal actor that is Alpha.

4.1.3 Orchestrating external and inter-organizational knowledge management

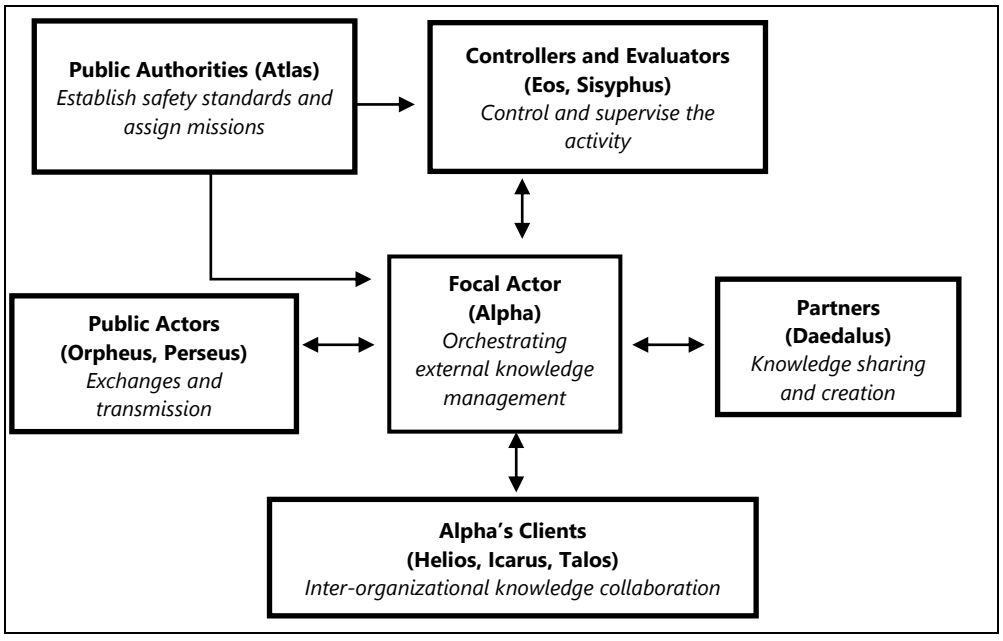

Figure1: Kronos ecosystem

As shows it figure 1, interactions induced by the regulated safety context materialize between three groups of Kronos's members: public authorities that establish safety standards and assign missions (Atlas), controllers and evaluators

who control and supervise the activities from a safety perspective (Eos Sisyphus), and a focal actor (Alpha).

Alpha appears as a focal actor of Kronos as it is positioned as an orchestrator between actors achieving control processes and three other groups of actors. The first other group of actors includes members of Kronos who are concerned by knowledge transfer (Orpheus and Perseus), those who are concerned by knowledge generation (Daedalus), and those who are concerned by knowledge collaboration (Helios, Icarus, Talos). Both three groups must comply with its standards in their knowledge management processes. The focal role of Alpha is then characterized by its capacity to ensure the flows between knowledge management processes and enforcement of regulatory standards. In other words, Alpha is the focal actor of the ecosystem, because it is in charge of ensuring the coordination and collaboration among all groups of actors.

> *"Afterwards, at the national level, I consider that everything must come from [Alpha]. It is the official actor who is in charge of [the ecosystem activity] and it must come from [Alpha], not to formalize knowledge, but to establish rules. And then, of course, it also comes from [Alpha] through [a common knowledge base], etc. To have a level of knowledge and capitalization of knowledge that is somewhat the basic foundation. After that, it's up to each actor to build on this base, to develop methods and elements of standardization and knowledge management within the organization. This is what we do, in a more or less formalized way." (#33)*

However, sustainable knowledge creation also requires organizational innovation in the form of the development of a knowledge management system at both intra and inter organizational level.

4.2. Organization of knowledge management process at the internal level

To create and share sustainable knowledge, the actors of the ecosystem must implement an inter-organizational knowledge system. To this end, actors must first innovate in their intra-organizational architecture by building a knowledge management system within their own organization.

To take part in the inter-organizational knowledge flows within the ecosystem, actors must each have a knowledge management system at the intra-organizational level. In the case of Kronos, some actors did not have internal knowledge management systems, or their knowledge management systems were not sufficiently well organized to meet the objectives of inter-organizational knowledge management at the ecosystem level. To fill this gap, progressively, the

main actors in the ecosystem have initiated different approaches to manage their knowledge internally.

4.2.1 Organizing internal knowledge management through four stages

This was done through different stages that lead to the construction of different knowledge systems. We named these stages as follows: (1) Needs, (2) Means, (3) Objectives, (4) Structuring.

At the first stage, actors identify the knowledge management (KM) needs.

> *"[Helios] has become aware, [Helios] became conscious of the fact that KM was important and that it would not be bad if we had a centralized management and at least a common methodology and that we could share, since as I said, each one was doing their own thing in their own corner, which does not mean that it was not good, but simply that it is true that it is perhaps more interesting if we can have an extended model that can be used by the whole organization." (#40)*

Organizations in the ecosystem have gradually become aware of the need and interest in managing their knowledge, through various factors and triggers related to the regulated safety context or to internal organizational needs. At the regulated safety context, there may for example be external institutional pressures (e.g.; new standards or recommendations). At the internal level, there is for example the need to fill the risk of knowledge loss or to codify individual knowledge of experts from organizations likely to leave the ecosystem (for retirement, or a new job, etc.). Those needs can be identified at the hierarchical level of the organizations (the board of directors).

> *"I can confirm that this is a common problem for all the actors within [the ecosystem] (…) retirements (…) are a problem for [the ecosystem]". (#40)*

At stage two, organizations give to itself the means to enable the implementation of KM processes. This requires some organizational changes or evolutions within their own organization to initiate a global internal knowledge management process.

> *"[The support of the board of directors] is absolutely essential because we are in activities that have a lot of difficulty measuring their value (…) And so, either there are heads who are convinced of this and who think that there is a close association between general knowledge or shared knowledge and performance in general, or to avoid nonsense. Well, if they believe it, that's fine. If they don't believe it, it's very hard to prove it to them. There are ways to get around it. At the end of the day, you have to*

have metrics, you have to bring metrics. You have to give confidence." (#31)

At stage three, organizations set the targets to be achieved in terms of KM. They implement knowledge management processes within their borders according to different purposes and to reach several objectives. In the short term, these objectives consist of filling the need to codify tacit knowledge at risk of loss. In the long term, it is about improving performance, facilitating organizational innovation, and creating a knowledge memory.

> *"Knowledge management must meet your needs and your operational goals. It is even a guarantee of a more solid anchoring than a theoretical approach that would be diffused." (#38)*

And at stage four, actors' structure intra-organizational KM processes. They progressively built and organized their knowledge management process in a systemic way.

> *"[At Daedalus] we have defined a matrix [of the knowledge system] with different themes. So, we have five themes: knowledge transfer, knowledge sharing, capitalization, storage and distribution. And for each of these themes, we have identified three topics, and so the objective for us in the knowledge management program is to transform employee knowledge into corporate knowledge and make it accessible to everyone when needed." (#41)*

4.3. Moving towards the emergence of a non-precompetitive knowledge ecosystem through the development of an inter-organizational knowledge management system

As Kronos's actors evolve in a non-precompetitive but safety regulated context, the organizational innovation operated at the intra level also contribute to the development required at the inter-organizational level. Kronos emergence is materialized by the development of an inter-organizational knowledge management system facilitated through three enablers and three mechanisms of emergence.

4.3.1 Enablers of emergence

The first enabler of Kronos emergence is the sharing of KM approaches between actors. The different knowledge management approaches of organizations will lead to be shared and disseminated in the context of their interactions. The second enabler is the sharing of knowledge bases and KM tools

between actors. Because of their cognitive proximity in terms of knowledge management, actors are led to share and have a certain number of common KM devices and tools. And the third enabler is the sharing of good practices between actors. In their operational interest and to reach the goals of their knowledge management approach, actors share their good practices and their feedback on knowledge management.

> *"We have a very strong ecosystem with companies to which we are closely linked. And it is essential that these companies know how to keep their knowledge to ensure the quality and monitoring of manufacturing. So, we intervene. We regularly intervene with partners to help them capitalize on their know-how, on their technical gestures or things like that." (#30)*

4.3.2 Mechanisms of emergence

The organizational innovation operated at the intra-level results in an improvement of actors' practices which in turn serve at the inter-organizational level. This leads them to organizational innovation in the way they organize and operate at the ecosystem level. Three inter-organizational KM mechanisms facilitate the emergence of Kronos. First, in the context of their activities and regulatory obligations, actors are led to exchange, combine and create knowledge in a sustainable way. The first mechanism is then knowledge processes between actors. The second mechanism is the development of common KM practices and issues within the ecosystem. Due to a common culture, actors have a certain cognitive proximity, which in terms of knowledge management translates into shared practices and issues. And, the third mechanism relay on actors' continuous learning to improve their practices and way of doing things through regular exchanges between them. The regular interaction of actors in charge of knowledge management in different organizations leads to the improvement of their practices and way of doing things through continuous learning.

> *"There are many aspects, subjects that concern us, but also [the ecosystem activity] itself, that are actually learning and are in a continuous learning perspective. And so, the more we learn and the more we develop practices, we identify best practices. These identified best practices are able to change the organization. And our goal is to do this continuously. And we are perfectly aware of different aspects that the organization modes or certain current practices are not the best or in any case, it could be better. There are avenues on this too, there is work, anyway, that aims to seek better ways of doing things, on all subjects." (#36)*

4.3.3 Obstacles

There are however two obstacles to face during the emergence process of Kronos ecosystem. First, the ecosystem actors are gradually moving towards inter-organizational knowledge management despite the challenges and difficulties identified. Second, the initiation of systemic shared knowledge management between ecosystem actors, lead the ecosystem to move towards systemic inter-organizational management.

> *"Today we have a basic foundation and a process that is established by [Alpha], but today we do not have a common rule (…) I would say that today we have methods and processes for knowledge management, through for example everything that is [shared knowledge base]. This is the foundation. And these processes are then declined in the knowledge file, knowledge control and [product] processes. But there is still a part, a part where we don't have, we remain at the macro level (…) But certainly for me, we would have feedback to share, that is, we take the best [products] of all, and we all do the same, that would be great. But today, it's not like that. We don't have fine centralized management, nor our technical processes, and therefore not our knowledge management processes." (#33)*

5 Conclusion

This paper examined the case of the ecosystem Kronos. It aimed to understand what type of knowledge ecosystem Kronos is. And to specifically study how such a new type of knowledge ecosystem emerge. The paper shows that Kronos is a non-pre-competitive knowledge ecosystem where actors' interactions are strictly collaborative due to its main goal: sustainable and inter-organizational knowledge management. The ecosystem's activities are organized through the development of projects involving long-term knowledge collaboration, where the role and missions of the actors are predefined. The regulated safety context structures furthermore the interactions between the ecosystem members in two ways: control (of security and safety) and collaboration. Emergence of the ecosystem is enabled by internal and inter-organizational innovation, i.e., the development of a knowledge management process. Organizational innovation is articulated within the actors' own (intra-organizational) knowledge systems, but also through the knowledge flow that is exchanged at the inter-organizational level.

To achieve this, ecosystem governance is ensured by a focal actor (a legitimate state actor), which is different from the focal actor of pre-competitive knowledge

ecosystem (a leading firm, or a research institute). In a non-precompetitive knowledge ecosystem, the focal actor assumes the role of orchestrator such as pre-competitive knowledge ecosystem. However, they differ in that, in non-precompetitive knowledge ecosystem (Alpha), orchestration activities are mainly ensured through regulatory legitimacy. The goal is to ensure the sustainable flow of knowledge through coordination and collaboration of ecosystem members.

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The Power of Words? Persuasive Language Style and Performance in Equity Crowdfunding

Bau-Jung Chang*

Department of Business Administration
Feng Chia University
100, Wenhwa Rd., Seatwen, Taichung, Taiwan 407, R.O.C.

Shijia Liu

Department of Business Administration
Feng Chia University
100, Wenhwa Rd., Seatwen, Taichung, Taiwan 407, R.O.C.

* *Corresponding author*

Abstract

This study takes the British equity crowdfunding platform Crowdcube as the research object, and explores the impact of the persuasive language style on the final performance of equity crowdfunding. This study uses the Linguistic Inquiry and Word Count Dictionary (LIWC) to carry out classification and frequency of vocabulary in the text. The results show that emotional language style has a significant positive impact on equity crowdfunding performance, which demonstrates that using positive emotions of entrepreneurs can most arouse investors' empathy and then invest. Besides, social discussion provides positive signals for investors and is positively associated with equity crowdfunding performance. However, there is no significant impact on emotional language style on the crowdfunding performance. Finally, the study suggests writing styles of project content for entrepreneurs who raise funds through equity crowdfunding to reduce information asymmetry with investors, and at the same time use rhetorical techniques to improve their persuasive language and improve their fundraising performance. For example, it is suggested that entrepreneurs should make more use of emotional rhetoric when writing ideas, which can improve empathy and reduce psychological distance, so that investors can be more sure of the value of equity crowdfunding projects and attract more investment.

Keywords – Equity Crowdfunding, Information Asymmetry, Persuasive Language style

Paper type – Academic Research Paper

1 Introduction

Crowdfunding is a new channel for start-ups to obtain capital financing. Previous research has focused on reward-based crowdfunding, and less research

has been focused on equity crowdfunding. Investing in equity crowdfunding campaigns, investors receive not only a portion of dividends but also capital appreciation in the future. Therefore, information asymmetry is a serious problem in the context of equity crowdfunding (Vismara, 2018).

To overcome these asymmetries, entrepreneurs can communicate quality information to investors through the information provided in the project description. Related research discussing the determinants of equity crowdfunding is mostly based on the effects of product category, quality of signals, or entrepreneurs (Chan, Park, Patel, & Gomulya, 2018). However, information overload on the Internet causes decisions to be made quickly. Generally, investors browse the summary of fundraising projects quickly, and only if they are interested will they further research this fundraising project or invest further. Therefore, how the persuasive style of abstract text affects crowdfunding performance is the question explored in this study.

Studies discussing persuasive style language are only on reward-based crowdfunding (Angerer, Niemand, Kraus, & Thies, 2018; Kraus, Richter, Brem, Cheng, & Chang, 2016), and there are a few studies aimed at exploring the relationship of style language and performance of equity crowdfunding. Aristotle's Rhetorical Theory of Persuasion states that the persuasiveness of language changes attitudes and ultimately leads to differences in behavior. In general, following the rules of language use elicits a positive response from the recipient and increases persuasiveness. Persuasion is the process by which we try to change the attitudes of others (Mehran & Mahdii, 2016), and the role of persuasive language in advertising and communication has been extensively studied (Wright, Friestad & Boush, 2005). For example, Wang, Chen, Zhu, & Wang (2016) explored the influence of persuasive language on reward-based crowdfunding activities, and used Kickstarter to demonstrate that persuasiveness in the text is one of the important factors affecting investment decisions.

The language styles reveal the sentiment of human beings, and usually reflect the personality and psychological status. Some studies have found that language represents different dimensions of personality, such as Francis (1993), Kahn, Tobin, Massey, & Anderson (2007) and Joksimovic, Gasevic, Kovanovic, Adesope, & Hatala (2014).

In the business field, some studies from marketing aimed at the influence of social media on customer mindset (Kübler, Colicev, & Pauwels, 2020), and some studies focus on the relationship between linguistic style and crowdfunding success (Parhankangas & Renko, 2017). Although linguistic style has been

discussed in previous studies, what kind of language style and in what way for entrepreneurs and equity crowdfunding projects is still vague in the literature. Therefore, this study explores the relationship between language style and performance of equity crowdfunding, and employs the data from Crowdcube for empirical study.

2 Literature Review and Hypotheses Development

Equity crowdfunding (ECF) is a special kind of crowdfunding that involves offering shares issued by a fundraiser to investors and is therefore often subject to traditional securities laws and other regulatory restrictions. Access to financial resources is a fundamental challenge for entrepreneurs (Cassar, 2004; Gompers & Lerner, 2004). Previously, only wealthy individuals, venture capitalists and business angels could invest in startups. Therefore, startups have relied on financing from professional equity investors, especially venture capitalists (VCs) or business angels (BAs) to achieve early growth (Harrison, 2013). Emerging equity crowdfunding platforms democratize the investment process by opening the doors to a larger pool of potential investors, known as the "crowd". Over the decades, equity crowdfunding has evolved into a viable alternative to early established forms of equity financing (Block, Fisch & Praag, 2016). This form of funding allows startups to raise capital from many private investors in exchange for equity or profits through intermediary online platforms (Ahlers, Douglas, Christina & Denis, 2015).

In the context of equity crowdfunding, information asymmetry is a serious problem (Vismara, 2018). To overcome these asymmetries, entrepreneurs can communicate quality information to investors through the information provided in the project description. For example, studies have shown that equity retention,iformation and human capital can increase the likelihood of successful equity fundraising (Piva & Rossi-Lamastra, 2018; Vismara, 2016; Ahlers et al., 2015). These signals are usually provided by the entrepreneur and do not change during the crowdfunding campaign.

For crowdfunding activities, entrepreneurs use written materials on the platform to prove that their products or services are competitive and have great potential for future development, so as to convince investors to invest in them. Therefore, the persuasiveness of words in crowdfunding projects has a great impact on crowdfunding performance. This is similar to word-of-mouth marketing in the field of marketing. Traditional marketing scholars believe that word-of-mouth has two effects; perception effect (awareness) and persuasion

effect (persuasiveness) (Pang & Lee, 2008 ; Järvinen, Tollinen, Karjaluoto & Jayawardhena, 2012). The influence of the perceived effect of word-of-mouth on product sales comes from the description and transmission of basic product information in the text. However, there are few literatures that systematically study the persuasive effect of word-of-mouth marketing, especially the persuasiveness of language from the perspective of text analysis.

As an important supplement to word-of-mouth marketing, in addition to providing basic information on the quality of crowdfunding projects, its persuasive effect will have a significant impact on the investment behaviour of participants, and ultimately affect whether crowdfunding projects can successfully raise funds (Wang et al., 2016).

Reward-based crowdfunding projects can be seen as an appeal from entrepreneurs to investors, who are often emotionally inclined. Chen & Thomas & Kohli (2016) found that emotional information has an overall positive impact on successful fundraising goals in reward-based crowdfunding. Wang et al. (2016) research results show that appealing to emotion has a positive impact on the performance of reward-based crowdfunding activities. And studies have shown that emotional appeal is more important for hedonic products (Armstrong, 2010). Xiang & Zhang & Tao & Wang & Ma (2019) studied the kaishiba.com crowdfunding platform in China and divided supporters into two types: consumers and investors. Consumers support projects in the expectation of remuneration for the product et al., while investors seek financial returns. Research shows that emotional appeal has a greater impact on consumers than on investors.

Therefore, this study proposes the following hypothesis:

> *Hypothesis 1: Emotional language style is positively related to equity crowdfunding performance*.

Appealing to logic means that the speaker gives a speech in a logical deduction method, which is an effective means to smash certain rumors (Gentes & Selker, 2013). It falls into the category of appeals to reason in Aristotelian rhetoric. Rational appeals follow awareness, knowledge, likes, preferences, beliefs, and buying patterns. It may include detailed information about the product such as specific features, durability and value. Advertisements with rational rhetoric can make people more sure of the value of the product, and ultimately make a purchase. Rational appeals mainly persuade consumers through fact-based information and influence (Wang, Qiu, Kim, & Benbasat, 2016). Therefore, consumers usually make purchase decisions based on their

personal sense of logic and reasoning. Successful rational appeals depend on how persuasive they are or how persuasive their arguments are. The logic system of advertising display also has a significant impact on advertising effectiveness. Information that evokes logical judgments is likely to attract more investment (Smith & Berger, 1996). Studies have pointed out that in the 13 most successful crowdfunding projects, the initiators used logical language expressions in project descriptions to varying degrees (Tirdatov, 2014). Therefore, this study hypothesizes as below:

Hypothesis 2: Logical language style is positively related to equity crowdfunding performance.

Studies on marketing research have proven that online reviews are positively associated with sales volume or sales intention. Ahani, Nilashi, Ibrahim, Sanzogni, & Weaven (2019) predict that online hotel reviews are evaluations of product quality for other customers. For those who are searching for products or services, online reviews play an important role in judging the advantages or disadvantages based on the experience of reviews.

In a systematic review of e-marketing activities of star-ups, Chakraborti, Dutta, & Jana (2022) found that customers rely on online reviews for further purchasing. The behaviour may result from a signal theory that the new customers collect related information before decision making (Siering, Deokar, & Janze, 2018). More discussion in the fundraising projects shows more investors interested in this project, which may lead to successful performance (Ahlers, et al., 2015). Therefore, this study hypothesizes as below:

Hypothesis 3: Social discussion is positively related to equity crowdfunding performance.

3 Methods

3.1 Data

The data for this study collected from the fundraising target, corporate philosophy and business plan is from the period from August 1, 2021 to August 1, 2022 on the Crowdcube website. The data collection process follows the rules as below. First, the interception of the data is at the end of the project. Second, the items of the last day for each project are summarized into a list. Third, project content includes company name, release date, target amount, final fundraising amount, idea, business plan, etc. are collected. There are finally 241 projects in the data pool.

Francis & Pennebaker (1993) conducted text analysis on the text data that people usually write. They classified the words, and then compiled a dictionary of words after calculating the words by programing. A text analysis application called Linguistic Inquiry and Word Count (LIWC) has been well developed after that.

This study used the fifth version of LIWC (LIWC-22), consisting of nearly 6,400 words, word stems, and curated emoji. The LIWC program includes the main text analysis module as well as a set of built-in dictionaries. After the processing module reads and counts all the words in the given text, it calculates the percentage of the total number of words that match each dictionary category. For example, if LIWC analyzed 2,000 words and compared them to the built-in LIWC dictionary, it might find that 150 pronouns and 84 positive emotion words were used. It converts these numbers into percentages; 7.5% for pronouns and 4.2% for positive emotional words.

This study mainly focuses on the language style analysis of the "idea" part in each equity fundraising project, for the following reasons. First, the idea is located in the first category of the webpage of crowdfunding projects, mainly used for project overview, and attracts investors' interest with short text. When investors are interested in the content presented in the concept of the company, they will apply to the company for its plan and other internal materials. Therefore, a convincing idea is very important for crowdfunding projects. Second, the team qualification is mainly for the personal introduction of entrepreneurs, and fewer rhetorical techniques will be used. Third, there are many complicated texts in the business plan and other content, which may result in errors in the processing process. The content of the idea is streamlined, and the consistency and accuracy of the also higher for all projects.

3.2 Variables

Dependent variable

Equity crowdfunding performance. The performance of equity crowdfunding is defined as the success rate of fundraising on the last day of the crowdfunding project. Fundraising amount on the last day / target amount × 100.

Independent variables

Emotional language style. This variable uses all the vocabulary categories related to emotion in the LIWC dictionary, which includes the categories of positive emotional tone (tone_pos, emo_pos). The sum of the percentages of LIWC's final use of emotional words is calculated.

Logical language style. In this study, the words which are related to logic are classified into the lexical categories of logic in LIWC, including conjunction words (conj), insight words (insight), and causal words (cause). The sum of the percentages of LIWC's final use of these categories is calculated.

Social discussion. The variable of social discussion refers to the amount of discussions that investors or members of Crowdcube publish regarding the focal company. The variable indicates the signals that investors are interested in this company. The natural logarithm of the variable is calculated.

Control variable

Risk assurance. In England, the government provides income assurance projects, including the Enterprise Investment Scheme (EIS) and Seed Enterprise Investment Scheme (SEIS), encouraging investors to invest in new ventures. EIS and SEIS are used as a measure of risk assurance variables, and are recorded as 1 if the fundraising project has been included in EIS and SEIS, otherwise recorded as 0.

This study used SPSS 22 to test the internal consistency of all variables, and hypothesis testing was performed through multiple linear regression analysis.

4 Results

Table 1 illustrates the correlation coefficients of all variables used in the regression analysis.

Table 1 Descriptive statistics and Pearson correlation matrix

Variable	Means	S.D.	1	2	3	4
1 Equity crowdfunding performance	1.46	0.82	1			
2 Risk assurance	0.78	0.42	0.05	1		
3 Emotional language style	3.52	2.03	0.07	0.00	1	
4 Logical language style	8.02	2.43	-0.04	-0.03	-0.06	1
5 Social discussion	2.52	0.76	.447**	0.02	-.162*	-0.02

Note: n =241, *: p<0.05, **:<0.01, ***:p<0.001

Table 2 shows the regression results in this study. All independent variables and control variables were used in the regression model. The results show that the F-value is 16.043, reaching a significant level (p<0.01). Therefore, the regression model is predictive. The R-square in this model is 0.22, which is less than 0.7. It may result from the limitation of data collection. We suggest future research may collect other kinds of data to enlarge the dataset.

Table 2 Regression Model

Variables	Y=Equity crowdfunding performance
Risk assurance	.014
	(0.118)
Emotional language style	0.140**
	(0.024)
Logical language style	-.026
	(0.020)
Social discussion	0.469**
	(0.065)
F value	16.043***
R-squared	0.22
Adjusted R-squared	0.207
N	241

Note:
1. standard errors are in brackets
2. *: p<0.05, **:<0.01, ***:p<0.001

In Table 2, the coefficient of risk assurance is 0.014, which is positive but does not reach a significant level. The coefficient of emotional language style is 0.140, which is positive and reaches a significant level. The results show that emotional language style and social discussion are positively correlated with equity crowdfunding performance, but logical language style is negatively correlated with equity crowdfunding performance but fails to reach a significant level. Therefore, hypothesis 1, that emotional language style is positively associated with equity crowdfunding performance, hypothesis 3, that social discussion is positively associated with equity crowdfunding performance are both supported. However, hypothesis 2, that logical language style is positively associated with equity crowdfunding performance, fails to support it.

5 Discussion and Conclusion

This study has several contributions. First, this study enriches the literature on equity crowdfunding activities in the field of signaling theory. Most of the previous literature on crowdfunding focused on incentive-based crowdfunding. Although most of the research on equity crowdfunding was based on signaling theory (Ahlers et al., 2015; Vismara, 2016), the research was focused on making crowdfunding campaigns through tangible products or entrepreneurial factors. In contrast, from the perspective of text content, this study tries to explain how the language styles affect the results of equity crowdfunding, and confirms that social discussion has a significant impact on crowdfunding performance.

Second, this study confirms the impact of a persuasive language style on equity crowdfunding, extends Aristotle's rhetorical theory to the field of equity crowdfunding, and finds that emotional expressions are important rhetoric for equity crowdfunding.

Third, the results show that the more the number of investors that investors publish regarding the project, the higher the equity crowdfunding performance. The results demonstrate that the more discussions about the new ventures seem to provide a signal for other investors.

The findings of this study have important implications for entrepreneurs of start-ups in equity crowdfunding platforms for writing project content. Correct and effective text content can help entrepreneurs communicate their ideas to investors, let investors better understand the content of equity crowdfunding projects, and improve their investment desires. The results suggest that consideration of the following recommendations may increase the success rate of equity crowdfunding campaigns. First, this study can guide entrepreneurs in generating attractive text descriptions. It is suggested that entrepreneurs should make more use of logical and emotional rhetoric when writing ideas, which can improve persuasion and reduce psychological distance, so that investors can be more sure of the value of equity crowdfunding projects and attract more investment.

Second, businesses with EIS and SEIS should pay more attention to the interpretation of risks. Because EIS and SEIS only protect the rights and interests of British investors and reduce their investment risks, but for investors in other countries, they can only be used as a reference. The specific investment risks need to be understood through other content in the crowdfunding project. Therefore, entrepreneurs who have EIS and SEIS need to be prepared for danger in times of peace, not only rely on this risk protection factor, but also send other risk protection quality signals to investors to attract more investment from non-UK investors.

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Green Intellectual Capital: A Hot Research Front in the Vast Field of Green

Pedro Seva-Larrosa*

University of Alicante
Department of Management.
P.O. Box 99, ES E-03080. Alicante, Spain

Francisco García-Lillo

University of Alicante
Department of Management.
P.O. Box 99, ES E-03080. Alicante, Spain

Bartolomé Marco-Lajara

University of Alicante
Department of Management.
P.O. Box 99, ES E-03080. Alicante, Spain

Eduardo Sanchez-García

University of Alicante,
Department of Management.
P.O. Box 99, ES E-03080. Alicante, Spain

** Corresponding author*

Abstract

The need for environmental awareness and green management in business and management arenas has led to green becoming a vast field that needs to be parcelled out to identify the green shoots. Knowledge is emerging as the key factor in developing a green awareness in companies, which has come to be called green intellectual capital (GIC). The objective of this research is therefore twofold. First, to identify and map the existence of active research fronts in the field of green through a bibliometric analysis (bringing green shoots to the surface); and second, to analyse in depth the GIC research front previously identified in this paper (one of the green shoots that emerged) and to offer new insights into it. We analysed 4,180 articles (4,142 for the identification of green research fronts and 38 for GIC) from WoS published between 2008 and 2022. Amongst the potential contributions made by this study include characterising 19 of the most active research fronts on green in business and management, as well as to know what advances have been made (and what remains to be done) in the literature on GIC.

Keywords – Green, Business and management, Green intellectual capital (GIC), Bibliometrics, Bibliographic coupling analysis (BCA).

Paper type – Academic Research Paper

1 Introduction

Green issues have become a topic of interest for both academics and practitioners in different spheres worldwide. The need for environmental awareness and green management evolves from a variety of wrongdoings that have transpired over time (Pane Haden et al., 2009). Business has not escaped this interest in green issues and in recent decades has become increasingly concerned with incorporating sustainability aspects into business management, through their corporate, competitive, and functional strategies. In this way, many organisations are trying hard to become more sustainable organisation (Yusoff et al., 2019), for example, by incorporating green business strategies (Leonidou et al., 2017), by developing green entrepreneurship (Silajdžić et al., 2015) or green business innovations (Lin et al., 2011) leading to green business models (Nair & Paulose, 2014). Although the introduction of green in business goes back several decades, business and management researchers have made considerable efforts to contribute new knowledge on green and environmental issues in recent years. Data provided by Web or Science (WoS) show that the production of scientific articles on green has quadrupled in the last decade (2012-2022), which gives an idea of the relevance and maturity of the field.

As a field or domain of research enters its stage of maturity, it fragments into different areas that are more specific or address particular problems. To use a recent analogy, as the Coronavirus matured, that is, as it spread as a pandemic among the world's population, new variants emerged, bringing with them new challenges and particular problems that consequently required new methods and strategies to be addressed by the scientific community. Similarly, the maturity of the green field in business may have led to the emergence of different lines or fronts of green research. Precisely, our first research question deals with this issue.

> *RQ1: Has the maturity of green in business and management led to the consolidation of different research fronts in this area?*

To answer this research question, we conducted a quantitative literature review on "green" in business and management. There are different types of quantitative literature review methods, among which bibliometric analyses are outstanding due to their robustness and reproducibility. Some studies have used author co-

citation (ACA), document co-citation (DCA), or co-word analysis (e.g., Chen et al., 2010; Leydesdorff & Welbers, 2011; Zhao & Strotmann, 2011). Others have employed the bibliographic coupling analysis (BCA) (e.g., Boyack & Klavans, 2010; Chen et al., 2011; Glänzel & Thijs, 2011). There is yet another group of scholars who have jointly used some of these analysis techniques; ACA and co-word analysis (e.g., Zitt et al., 2011) or co-citation and text-based analysis (e.g., Saft & Nissen, 2014; Mora et al., 2019). This study combines BCA and SNA techniques to explore our first research question. For this purpose, a total of 4,142 scientific articles published over the last decade (2012-2022*) were analyzed.

Once the research fronts on green have been identified, we focus on analysing one of the fronts that in recent years is arousing great interest among researchers and business practitioners, i.e., green intellectual capital (hereinafter, GIC). In the era of knowledge economy, the significance of intellectual capital has been increasing globally. Similarly, recent studies have focused on the importance of GIC in mitigating environmental degradation (Ali et al., 2021). The concept of GIC was introduced in the seminal work of Chen (2008) and has become a booming field today. The author defines it as "the total stocks of all kinds of intangible assets, knowledge, capabilities, and relationships, etc. about environmental protection or green innovation in the individual level and the organization level within a company" (p. 277), and his proposal considers three types of green intellectual capital: green human capital, green structural capital, and green relational capital. This concept emerged in the academic literature with the aim of emphasizing the importance of the environmental intangibles possessed by the organization to improve the organization's competitive position. Therefore, our second research question is related to the existing knowledge on GIC.

> *RQ2: What progress has been made (and what remains to be done) in the literature on GIC from the emergence of the concept until now?*

To answer this research question, we conducted an in-depth analysis of the 38 articles published on GIC in WoS from the origin of the concept to the present day (2008-2022). We employ a combination of bibliometric analysis techniques that provide insight into the most relevant articles, journals, institutions, and countries, as well as a content analysis that offers new insights into the approach of the works, the type of analysis, the analysis technique used, the country in which the study was conducted, the industry analysed, the sample used, the way the GIC construct is measured and the relationships tested.

In sum, this research pursues a twofold aim: (1) to identify and mapping the existence of active research fronts in the field of green through bibliographic

coupling analysis (BCA) and social network analysis (SNA); and (2) to analyze in depth the GIC research front previously identified in this paper and to offer new knowledge about it.

This paper contributes to the previous literature at least in two ways. On the one hand, to the best of our knowledge, there is no review of the literature using bibliometric techniques that identifies research fronts in the field of green-related business and management, which provides a prospective approach on research (Verbeek et al., 2002; Vogel & Güttel, 2013). This is of value to researchers who wish to have a clear and structured map of the established lines of research in this field and thus be able to focus their efforts on one of these fronts or alternatively to develop new original proposals to existing ones. On the other hand, the detailed analysis of one of the fronts allows researchers concerned with GIC to have structured knowledge, to identify gaps that offer opportunities to develop high impact research and to know the road already travelled and the future research avenues.

The remainder of this article is organized as follows. Section 2 discusses the methodological design of the research. Section 3 reports the results obtained as well as their discussion. Finally, Section 4 shows the main conclusions and implications of the study.

2 Materials and methods

2.1 Research design

The methodological design employed in this study includes two clearly differentiated stages: (1) the identification and mapping of green-related research fronts and (2) the in-depth analysis of one of the previously identified research fronts (see Figure 1).

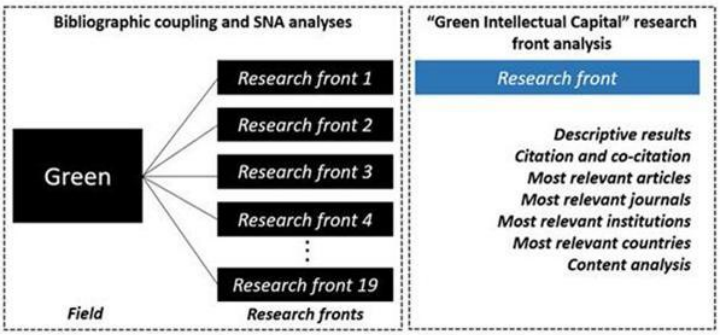

Figure 1. Methodological design.

First research stage: Bibliographic coupling and SNA analyses

Since, as stated by some authors (Aria & Cuccurullo, 2017), science mapping is complex and unwieldy because it is multi-step and frequently requires numerous and diverse software tools, at the first stage of the research different analyses have been carried out and different software has been used. Particularly, for the exercise of identifying and mapping active research fronts two types of analysis have been conducted: bibliographic coupling analysis (BCA) and social network analysis (SNA).

Bibliographic coupling analysis, proposed by Kessler (1963), reveals the connection between documents based on overlapping bibliographic references (Bretas & Alon, 2021). Bibliographic coupling analyzes the similarity between two documents using the number of references shared by them (Elango, 2019; Sánchez-Famoso et al., 2020; Zupic & ˇCater, 2015). Thus, two articles citing a third publication, i.e., two "citing" documents, are coupled because high instances of mutual references in their bibliographies suggest an intellectual capital common to both (Xu et al., 2018; Khanra et al., 2021), a shared related topic (Maseda et al., 2022, p. 282), or a high thematic affinity (Kessler, 1962: 1963). Precisely, the interest of studies based on the application of BCA lies in the fact that documents connected by strong bibliographic coupling links can provide insights on the structure of research fronts within a field or academic discipline in terms of thematic relatedness (Vladutz & Cook, 1984; Peters et al., 1995; Jarneving, 2007a, 2007b).

In contrast to co-citation analysis, this technique by capturing the most recent contributions (Zupic & ˇCater, 2015) allows to detect current trends and future priorities reflected at the forefront of research (Vogel & Güttel, 2013), being therefore suitable for identifying "hot" research topics (Glänzel & Czerwon, 1995: 1996; Jarneving, 2007a, 2007b). Based on the above and given that the choice of method depends on the research objective, we chose the bibliographic coupling technique over other bibliographic techniques such as co-citation. We also used SNA to build, visualize and analyze the bibliographic coupling network.

Second research stage: GIC research front analysis

The second research stage allowed us to gain a deeper understanding about one of the research fronts identified in the previous stage. Thus, in this stage we proceeded to the selection of one of the fronts to conduct an in-depth analysis of the topic addressed by that front. As mentioned above, in the era of the knowledge economy and sustainability concerns, the importance of green-related intellectual capital for reducing environmental damage (Ali et al., 2021) has

become increasingly important in recent years. For this reason, we selected the GIC research front.

We employ a combination of bibliometric analysis techniques and a content analysis to characterise the research front analyzed. The potential of content analysis lies in its combination with other methods (Gaur and Kumar, 2018), such as bibliometrics (Foguesatto et al., 2021). Bibliometrix® was used for data analysis and visualisation. This is an open-source R-package, developed by Aria and Cuccurullo (2017), which provides a tool for quantitative research in bibliometrics and scientometrics. Compared to most free software (e.g., CiteSpace and VOSviewer), Bibliometrix does not only focus on data visualization, but also on the correctness and statistical completeness of the results. Figures 3, 4 and 5 and tables 3, 4, 5 and 6 shown in the results section provide some examples of the output that can be obtained using Bibliometrix.

2.2 Data collection

For rigorous bibliometric studies, data collection consists of three stages: (1) data retrieval; (2) data loading and conversion into a format suitable for the bibliometric tools used; and (3) data cleaning. To curate relevant research for this study, we limited our search to the Web of Science Core Collection™ database (WoS). Specifically, we used one of its indexes: the Social Sciences Citation Index (SSCI). Since the simultaneous use of different databases is unhelpful owing to duplication of records (Harzing & Alakangas, 2016) and WoS is considered the 'gold standard' database for measuring scholars' performance, WoS was our election.

From this database, only peer-reviewed academic journal articles in the English language were retrieved and excluded all other document types such as books, book chapters, conference proceedings or documents containing reviews or notes. According to some authors (Merton, 1973), only peer-reviewed academic journal articles can be seen as "certified knowledge", since the review process itself acts as a control mechanism to validate knowledge (Light & Pillemer, 1984; Ordanini et al., 2008). Moreover, the use of articles constitutes a common practice in these type of studies (e.g., García-Lillo et al., 2023).

The execution of the search equation in WoS, together with the criteria described above, yielded a dataset consisting of 4,142 articles on "green" published between 2012 and 2022[*]. Once the data were obtained, they were prepared (data conversion and cleaning) for use in the BCA. Table 1a details the search criteria for the dataset that constitutes the first sample of our study.

Table 1a. Search criteria for obtaining the dataset on green.

Database	Clarivate Analytics' Web of Science Core Collection™
Citation Index	SSCI (Social Sciences Citation Index)
Search field(s)	TOPIC (searches title, abstract, author keywords, and keywords plus)
Topic(s)	"green"
Subject categories	Business and Management
Time span	2012-2022*
Document type	Article
Language	English
Final sample	4,142 articles

Once the research fronts were identified, another data collection was conducted, in this case, referring to the topic of the research front on which the in-depth analysis was performed. The procedure was like that used to obtain data from the first research stage. After establishing the search criteria for WoS, a total of 38 articles were obtained as a dataset representing the second sample of our study. Table 1b details the search criteria used.

Table 1b. Search criteria for obtaining the dataset on GIC.

Database	Clarivate Analytics' Web of Science Core Collection™
Citation Index	SSCI (Social Sciences Citation Index)
Search field(s)	TOPIC (searches title, abstract, author keywords, and keywords plus)
Topic(s)	"green intellectual capital"
Subject categories	Business and Management
Time span	From any time up to 2022
Document type	Article
Language	English
Final sample	38 articles

2.3 Data analysis for bibliographic coupling and social network

2.3.1 Treatment of bibliographic records, document selection and calculation of bibliographic coupling and proximity matrices

The 4,142 articles analyzed were processed with Bibexcel®, a versatile tool for bibliometricians designed for the processing of bibliographic data. Bibexcel allows to extract the information included within a bibliographic record using any document's field or some combination of these fields. In this study, Bibexel was not

only used to extract the reference list from each of the bibliographic records but also to quantify, for each pair of source documents, its coupling strength.

For BCA, we considered all those citing documents with a coupling strength of at least 27 shared references (tie strength ≥ 27) with at least one of the remaining documents in our dataset. BC occurs when two scholarly works cite a common third work in their reference lists. So, two documents are bibliographically coupled if they both cite one or more documents in common. The cut-off point mentioned above allowed us to obtain a bibliographic coupling matrix $[C(c_{ij})_{nxn}]$ of dimensions 252x252 with the amount of cited references in common between each pair of citing documents in the sample. Once a bibliographic coupling matrix $C(c_{ij})_{nxn}$ has been constructed the next step in the application of BCA consists of calculating a proximity matrix $[S(s_{ij})_{nxn}]$.

2.3.2 Construction of the bibliographic coupling network

Once the bibliographic coupling and proximity matrices were constructed, we performed a factor analysis (FA) as a further step in the application of the BCA. FA by means of principal component analysis (PCA) with varimax rotation applied on matrix $S(s_{ij})_{nxn}$, led to the extraction of up to 108 factors with eigenvalue ≥ 1. From these factors, only those comprising at least three (node degree ≥ 2) of the primary-source documents with loadings above 0.7 in absolute value were retained for further analysis. The reason for this way of proceeding was to remove all those sources documents –also known as citing documents– that did not significantly load in any of the extracted factors. Following the application of these criteria/parameters (tie strength ≥ 27; eigenvalue ≥ 1; node degree ≥ 2; and loadings ≥ |0.7|), the number of factors finally retained was nineteen, representing a total explained variance of 26.6%. In terms of documents, the final sample of primary source documents was reduced from 4,142 to 64 articles representing the BC network nodes.

Finally, we took the output of the preceding analysis as input for subsequent SNA using Gephi version 0.9.6. This is an open-source software (OSS) that utilizes a three-dimensional render engine to provide expressive and insightful visual illustrations of large networks (Jacomy et al., 2014). Specifically, we use the 'Force Atlas' algorithm provided by Gephi to compute the layout of the nodes of the BC network. This allowed us to visualize the research streams identified in this study. The SNA carried out conceptualizes the citing documents as nodes and their relationships to each other as lines between the nodes.

3 Results and discussion

This section shows and interprets the results of the BCA and SNA on green conducted in this study, as well as the in-depth analysis of the GIC research front.

3.1 BCA and SNA results – Identifying research fronts

Figure 2 shows the layout of the BC network comprising the 64 citing documents mentioned above. For ease of understanding, the network was visualized in an aesthetically pleasing Force Atlas layout, which is a classic force-directed algorithm that uses the properties of the network to draw linked nodes closer and push unrelated nodes farther apart. This layout also allows consideration of edge weight for directed networks, such that the strength of different connections may be visualized at a glance (Cherven, 2015; Velden et al., 2017).

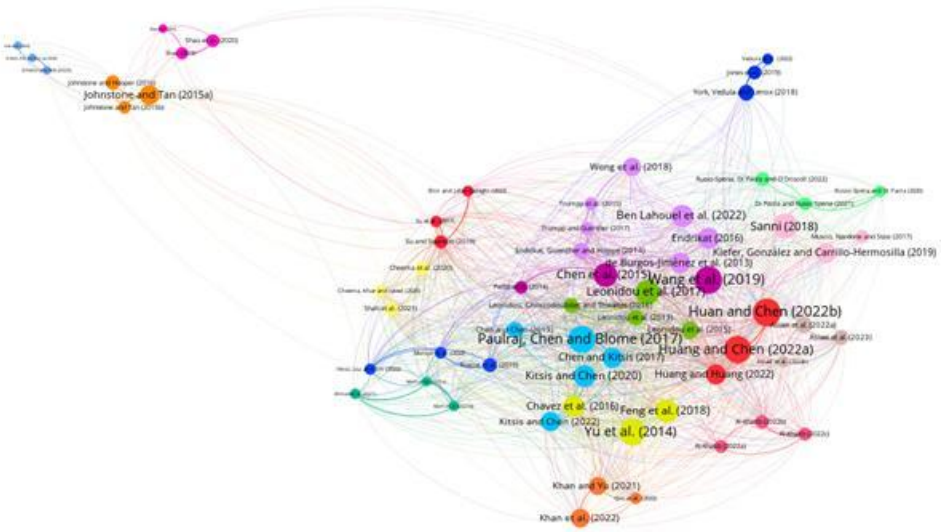

Figure 2. Bibliographic coupling network comprising the 64 citing documents included in the 19 research fronts identified in the study.

The color of each node in the network is indicative of the research front to which the citing document belongs among the 19 identified. In this research, the resulting groups of BC and SN analyses are defined, similarly to previous studies (García-Lillo et al., 2023), as "active research fronts" which shape the vanguard of knowledge and reveal current trends and future directions in the domain under

examination. The node diameters are scaled to their respective betweenness centrality degree, while the lines represent the relationships between nodes (i.e., the amount of overlap between the reference lists of each pair of such documents). Table 2 shows the 19 research fronts identified.

Table 2. Research fronts identified after the application of factor analysis upon Matrix S.

ID research front	Colour	Number of papers	Authors (year)
Research front 1		7 papers	De Burgos-Jiménez et al. (2013), Trumpp et al. (2015), Wong et al. (2018), Endrikat (2016), Trumpp and Guenther (2017), Ben Lahouel et al. (2022), and Endrikat, Guenther and Hoppe (2014)
Research front 2		4 papers	Leonidou et al. (2013), Leonidou et al. (2017), Leonidou et al. (2015), and Leonidou, Christodoulides and Thwaites (2016)
Research front 3		5 papers	Kitsis and Chen (2020), Chen and Chen (2019), Kitsis and Chen (2022), Chen and Kitsis (2017), and Paulraj, Chen and Blome (2017)
Research front 4		3 papers	Yu et al. (2014), Chavez et al. (2016), and Feng et al. (2018)
Research front 5		3 papers	Johnstone and Hooper (2016), Johnstone and Tan (2015a), and Johnstone and Tan (2015b)
Research front 6		3 papers	Al-Khatib (2022a), Al-Khatib (2022b), and Al-Khatib (2022c)
Research front 7		3 papers	Ahmad et al. (2021), Islam et al. (2021a), and Islam et al. (2021b)
Research front 8		3 papers	Asiaei et al. (2022a), Asiaei et al. (2022b), and Asiaei et al. (2022c)
Research front 9		3 papers	Russo-Spena, Di Paola and O'Driscoll (2022), Di Paola and Russo-Spena (2021), and Russo-Spena and Di Paola (2020)
Research front 10		3 papers	Huang and Chen (2022a), Huang and Huang (2022), and Huang and Chen (2022b)
Research front 11		3 papers	Hooi, Liu and Lin (2022), Roscoe et al. (2019), and Muisyo et al. (2022)
Research front 12		3 papers	Kiefer, González and Carrillo-Hermosilla (2019), Muscio, Nardone and Stasi (2017), and Sanni (2018)
Research front 13		3 papers	Wang et al. (2019), Paillé et al. (2014), and Chen et al. (2015)
Research front 14		3 papers	Cheema, Afsar and Javed (2020), Shah et al. (2021), and Cheema et al. (2020)
Research front 15		3 papers	Qin et al. (2022), Khan et al. (2022), and Khan and Yu (2021)
Research front 16		3 papers	Vedula et al. (2022), Jones et al. (2019), and York, Vedula and Lenox (2018)
Research front 17		3 papers	Shao et al. (2022), Shao et al. (2020), and Shao (2019)
Research front 18		3 papers	Shiri and Jafari-Sadeghi (2022), Su et al. (2017), and Su and

			Swanson (2019)
Research front 19		3 papers	Ertekin and Atik (2020), Atik et al. (2022), Ertekin, Atik and Murray (2020)

3.2 GIC research front results

The results of this section are not shown due to length limitations, for more information please contact the authors.

4 Conclusions

This paper has provided a review of the recent literature (2012-2022) on "green" in the areas of business and management, with the aim of identifying and mapping the existence of active research fronts through bibliographic coupling analysis (BCA) and social network analysis (SNA). Based on the analysis of 4,142 articles we were able to identify 19 of the most active research fronts in the field of green (see Table 2 and Figure 2). These results suggest that within the vast field of green, important research fronts are developing that have the potential to make advances in their respective areas. In many cases the new front involves the incorporation of the concept of sustainability or green into a topic already established in the literature. Examples include green supply chain management, green consumption behaviour, green human resource management or green intellectual capital.

Precisely, this paper has also provided an in-depth review into one of the previously identified research fronts, i.e., Green Intellectual Capital (GIC). For this, 38 articles published from the emergence of the concept to the present day were analyzed.

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The SURE Knowledge Synthesizer: A Conceptual Tool for Urban Sustainability Research

Ágota Barabás*

DigitalCity Science, Hafencity Universität
Henning-Voscherau-Platz 1
20457 Hamburg

Jörg R. Noennig

Digital City Science, Hafencity Universität
Henning-Voscherau-Platz 1
20457 Hamburg

Katharina M. Borgmann

DigitalCity Science, Hafencity Universität
Henning-Voscherau-Platz 1
20457 Hamburg

* *Corresponding author*

Abstract

The process of synthesis is key for the consolidation of new insights from existing bodies of knowledge, information, and data. In connection to other knowledge processes, e.g., inspiration, research or analysis, synthesis – as an activity of connection and convergence – is central to creating meaning and understanding. It builds upon principles of integration, unification, and generalisation as prerequisites for the inference of reliable and replicable knowledge. Synthetic processes are significant when dealing with large data sets or disparate and heterogeneous information. Especially in explorative research projects, the synthetic integration of a multitude of inputs is crucial to generating valuable and applicable knowledge output.

As a key idea, the paper puts forward the concept of a Knowledge Synthesiser as a heuristic device to shape the knowledge generated in larger research programmes. Resting on general models of information processing and knowledge life cycles, the Synthesizer is conceptualised as a system that generates meaningful knowledge output by interconnecting different functional layers and modules, e.g., for knowledge collection, structuring, or integration.

The specific case at stake is the German funding priority "Sustainable Development of Urban Regions" (SURE). Ten projects with approximately 150 partner institutions generate a large body of research about urban sustainability and innovation. The Synthesizer has been conceptualised to facilitate the convergence and integration of this knowledge and

to create insights about the SURE funding priority and about future urban development in general. Specifically, the Synthesizer has various practical purposes for the research programme:

- Structuring and safe-keeping the results from the ongoing research
- Allowing easy access to the research findings
- Enabling deep analysis of the collected data and information
- Linking information to create new insights.
- Outlining future trends in urban sustainability research
- Supporting research policy-making.

In response to the overarching research programme and its purposes, a system architecture has been created to be implemented as a prototype tool for the SURE funding priority. From the variety of functional and technical requirements, an overall schematic design has been created that eventually led to a Minimal Viable Synthesiser concept – the outline for the technical implementation of the key features and functionalities the Synthesizer needs to supply to the SURE funding priority.

Keywords – knowledge synthesis; urban sustainability; digital tools; digital transformation; transdisciplinary research; complexity

Paper type – Academic Research Paper

1 Introduction

Mathematician and science philosopher A. N. Whitehead (1967) stated that "knowledge does not last longer than fish". The statement hints at one key aspect of scientific research: knowledge creation is an ever-unfinished process. Knowledge needs permanent refreshment, update, and re-organisation. Every discovery may re-arrange the entire landscape of knowledge. There is a demand for continuous efforts in searching, hypothesising, analysing, and synthesising - and for the respective methodologies and devices that can support such an open-ended venture. Besides the strenuous activities of collecting data and assembling facts, producing scientific knowledge is a task of systematisation and integration that needs creative vision. A multiplicity of often contradictory findings needs to be structured, converged, and harmonised into a new unity. A multitude of facts, events and observations must be brought into a rational structure and drawn into a comprehensive picture. This holds true, especially for large-scale research programs generating a multiplicity of knowledge around a given single topic – which in turn need to be balanced, converged, and shaped into reliable scientific output.

The German funding priority "Sustainable Development of Urban Regions" (SURE) is such a case. The present paper revolves around the management and

synthesis of knowledge in this large research programme, bringing together almost 150 partner institutions around the topic of sustainable urban development. It tackles the difficult task of creating new (meta)knowledge from the vast landscape of "pieces of knowledge" in this programme. Comprehensive knowledge synthesis and consolidation are needed. Funded by the German Ministry of Education and Research (BMBF) between 2019 - 2025, ten intercultural and transdisciplinary research projects are generating a large body of research about urban sustainability and innovation, focusing on metropolitan regions and megacities in South-East Asia and China. In concert with the need for collaborative approaches that put people first in urban and rural developments and aligned with the SDGs localisation and the New Urban Agenda, SURE targets applied research, urban-rural innovation and transformative strategies.

Accompanying the SURE funding priority is the "Facilitation and Synthesis Research project" (SURE FSR), which supports the overall evolution of the ten projects and the programme itself and is supposed to consolidate the knowledge created in them. The SURE FSR conducts qualitative and quantitative meta-studies on the projects which conceptualise and test locally implementable solutions and strategies for the sustainable transformation of fast-growing urban regions. The SURE FSR project creates conceptual, theoretical, methodological, and translational innovations that integrate and move beyond discipline-specific approaches to address the issue of sustainable urban development and contribute to transdisciplinary research knowledge. Further insights on the overall research architecture of the SURE FSR can be found in the IFKAD23 research paper (ID 231) by Katharina M. Borgmann titled “The Research Architecture for Transdisciplinary Knowledge Synthesis for an Urban Sustainability Programme – A Meta-Study Methodology”. As a creative research project, it is mandatory to invent and explore new methods and instruments to effectively facilitate and integrate the vast research knowledge of the projects and the programme. The following sections establish the theoretical background, place the paper within the SURE framework, and set the research scope and boundaries.

2 Background

2.1 Sustainability Science

The global demand for sustainable development has pressured academia to establish the field of so-called Sustainability Science. According to Komiyama and Takeuchi (2006), Sustainability Science is a comprehensive and holistic approach

to identifying problems and perspectives related to the sustainability of global, social, and human systems. It is characterised as a problem-solving discipline, a transdisciplinary effort driven by the interplay of knowledge and action in environmental and social-cultural systems towards a liveable future (Kumazawa et al. 2009; Rapport 2007; Clark 2007). Sustainability Science is a "use-inspired basic research" – here, fundamental knowledge and pragmatic application are equally relevant (Clark 2007; Kajikawa 2008). Its knowledge generation rests on abduction-based synthesis, that is: new insights derive from justified assumptions or speculative hypotheses, which require validation through experiment and empirical research. The SURE Facilitation and Synthesis Research project aims to create a comprehensive and holistic knowledge synthesis approach to structure and consolidate transdisciplinary research results within the SURE framework. Yoshikawa (2008) theorises that "action based on abductive reasoning and the logic of synthesis can produce new forms of knowledge that will contribute to the creation of artefacts" – we explore and internalize this theory through the SURE FSR Knowledge Synthesis methods and conceptual tool discussed in this paper.

Sustainability Science is a problem-driven and solution-oriented field, following a transformation agenda and providing a vision and methodology (Steinfeld and Mino 2009), to deal with the complexities of sustainable development and to instigate knowledge structuring through multi-, inter-, and transdisciplinary approaches. Transdisciplinary approaches focus on the integration of knowledge from multiple scientific and societal sources through collaborative efforts. The ten projects within the SURE framework are characterized as Mode-2, transdisciplinary research projects (Slawski et al. 2022) they generate a growing pool of transdisciplinary approaches and sustainability knowledge. However, this knowledge is often based on literature and personal experiences. It still requires further consolidation and evidence-based principles to become useful and reliable for scientists and practitioners (Defila et al. 2006). Lang et al. (2012) emphasise the need for synthesising and consolidating the existing conceptual, methodological, and empirical knowledge of transdisciplinary research through qualitative and quantitative meta-studies.

2.2 Research framework and ambition of SURE

This paper and its findings feed into the meta-analysis and knowledge synthesis carried out by the SURE FSR project for SURE. Constrained by the SURE framework (limited geographical scope, number of projects, sample size for content analysis), the SURE FSR systematically examines and interprets the

findings of the ten transdisciplinary projects with qualitative and quantitative approaches.

With the findings, the SURE FSR aims to consolidate the existing conceptual, methodological, and empirical knowledge of transdisciplinary research and contribute to sustainable urban development and Sustainability Science. The SURE FSR overarching synthesis research architecture is elaborated, and its goals, objectives, and methods are discussed in the accompanying IFKAD23 paper "The Research Architecture for Transdisciplinary Knowledge Synthesis for an Urban Sustainability Programme – A Meta-Study Methodology". Preliminary research findings induced the formulation of hypotheses, of which the three listed below have relevance to this paper:

- Developing new methods and practices for knowledge synthesis aided by digital technologies will improve the consolidation, integration and comprehension of the large pool of knowledge generated in urban sustainability research.
- Targeted modelling of project contents and topic evolution will help indicate future challenges and issues to be addressed in urban sustainability research and policy making.
- Cross-analysis of programme documents and project content will contribute to recalibrating funding and proposal evaluation criteria.

Although the overarching meta-study is ongoing, this paper can present initial findings and first scientific framings in support of further investigations by the SURE FSR in the future years, also reaching beyond the scope of the SURE programme. The synthesis research targets three main aspects: Scientific classification to establish a reference and impact monitoring framework. Synthesis of project contents and findings, elaboration of problems and issues to be addressed in the future. Provision of digital infrastructure for knowledge management and decision support As its central argument, this paper puts forward the design of a comprehensive IT system (Synthesizer) and discusses its potential application. The system is intended to work as a versatile environment for the synthesis of knowledge by the SURE FSR and a decision-support tool for relevant stakeholders within the community of the SURE projects. Indicating the accompanying complexities in the development process of such a system, the text explains the opportunities and challenges such an instrument can bring for urban sustainability research.

2.3 The Principle of Synthesis within the Knowledge Lifecycle

The idea of the Knowledge Synthesizer takes its point of departure from discourses in knowledge theory and knowledge management, acknowledging that the topos of "synthesis" has long been a steady concern in the scientific literature. Throughout the history of epistemology and philosophy of science, various models have been proposed to conceptualise the dynamic evolution of knowledge that commonly leads from knowledge creation to knowledge sharing and diffusion. Recent knowledge and innovation management approaches advocate so-called knowledge lifecycles that model a dynamic process of knowledge creation, consolidation, and diffusion activities (Nonaka, 1991; Nonaka and Konno, 1998; McElroy, 2003; Dalkir, 2005).

Epistemologists, however, hold that the phases of knowledge creation, especially the interplay of hypothesis creation on the one hand and knowledge integration and consolidation on the other, are essential drivers of novelty and progress (Peirce, 1878; Polanyi, 1966; Popper, 2002). Not just since Kant´s inquiry into the limits of knowledge (Kant, 1781), synthetic procedures are seen as the key to generating new insights from existing bodies of knowledge, information and data. In connection with other modes of knowledge processing, the very capacity to structure and unify the multiplicity of input data and information into a consolidated and validated "larger picture" is central to creating meaningful, usable knowledge.

Synthesis work – as an activity of integration and convergence – searches the fundamental connective principles that allow reliable expression and replicable application of gained insights. Synthetic processes gain special significance when dealing with large sets of information and data or disparate and heterogeneous knowledge bodies. Extensive explorative research programmes like SURE need to purposefully structure and integrate the variety of findings created across the programme and its individual projects. Accompanying synthesis research thus becomes essential to ensure meaningful results for future research, result application, and policy making. Knowledge structuring and organisation are essential parts of the synthesis research activities. Nevertheless, structuring methods and approaches originate from a vast domain that needs more detailing than the constraints of this paper permits. Hence, the paper highlights some of the applied guiding principles in knowledge structuring: reusability, versatility, and accessibility, that are relevant to the conceptual design of the Synthesiser.



Figure 2: Synthesis processes within the knowledge life-cycle. Adaption of the knowledge management model of McElroy (2003) and Dalkir, (2005).

With a pragmatic perspective on the requirements for the synthesis research for the SURE funding priority, this paper – and namely the synthesizer concept presented in the following sections – assumes a simplified iterative process towards the synthesis and consolidation of knowledge (Fig. 1), adapted from established models in knowledge management (McElroy, 2003; Dalkir, 2005). It connects activities of knowledge capturing, hypothesis generation and rational analysis. Leaving the creative part of hypothesis generation ("abduction") as well as the rational analysis and critical reflection on the human mind, the paper focuses on the eminent activity of knowledge synthesis, targeting its potential support with the new conceptual and technical device of the Knowledge Synthesizer. To this end, the following section is 2.3. We will line out relevant technical solutions and propose an overall conceptual design and technical system architecture in section 3.2.

2.4 Technical Solutions

Acknowledging that knowledge integration and synthesis of existing bodies of (scientific) knowledge is a cognitive activity on higher levels of complexity than data or information processing, it is still worthwhile to investigate the currently available technological means for synthetic knowledge engineering. Information technology is increasingly used in sustainable urban development to unlock insights from data, helping decision-makers and planners make informed decisions about resource use and development strategies. Platforms such as Google Big Query, Snowflake, and Azure Synapse Analytics offer large-scale data

analysis services that collect and log data from various systems, including numerical and textual data. With AI's help, these platforms provide data processing and querying services and outputs from charts, diagrams, and dashboards. Understanding the interdependencies among socio-economic and environmental systems to achieve sustainable urban development is crucial. Data analysis platforms allow researchers and urban planners to collect and analyse data from multiple sources, including sensors, surveys, and administrative data, to understand urban systems comprehensively. The Urban Observatory platform, for example, enables users to compare data on various urban indicators worldwide, such as population density, air quality, and water usage. This platform provides a valuable resource for decision-makers and planners to identify areas where improvements can be made to achieve sustainable urban development. Other technologies, like Machine Learning and Artificial Intelligence, can be powerful tools to model and simulate urban systems, enabling urban planners to test different scenarios and assess the potential impacts of different development strategies. Text-based data is prominent in sustainable development, including reports, research, policies, regulations, and guidelines. In recent years, cities, governments, and academia have shown a growing interest in leveraging natural language processing (NLP) techniques to generate valuable insights and help planners and decision-makers to understand the social, economic, and environmental issues affecting urban areas. NLP can assist in analysing large volumes of textual data, extracting meaningful insights and providing a deeper understanding of urban systems. For instance, the Echobox platform offers a valuable resource for urban planners to extract and monitor public sentiment on social media. By analysing data from social media, planners can identify areas of concern and gain a deeper understanding of citizens' concerns and priorities. This information can then be used to design more effective solutions and policies better aligned with the community's needs.

Commercial NLP engines have benefits and drawbacks when creating insights from data in a specific field of research. Our preliminary study using IBM Watson or Monkey Learn for text analysis in sustainable development had good results in identifying locations and organisations and assessing the sentiment of the text; however, both platforms showed low accuracy and failed to determine field-specific information. Hence, engine training and adaptation of these platforms are crucial for meaningful information and knowledge extraction. In addition to commercial platforms, we have identified various initiatives amalgamating data science and sustainability, such as the Global System for Sustainable

Development (GSSD) and open-source platforms like Apache Drill. The GSSD is an open-source database established by the Massachusetts Institute of Technology (MIT), which offers a comprehensive perspective on worldwide sustainability predicaments. The GSSD follows a rigorous knowledge structuring approach incorporating ontology engineering and collating data from multiple sources, including scientific literature, government reports, and NGO publications, to offer a holistic view of sustainability issues. A visualisation tool is also available within the GSSD, which facilitates knowledge structuring and information clustering for exploring sustainability data.

The aforementioned platforms provide powerful tools using and harmonising real-time data sets and extract insights to understand the complex interactions between urban systems and citizens, promoting more inclusive and equitable urban development. Nevertheless, data analysis platforms rely on the data's quality and accuracy, which may be compromised by missing, incomplete or inaccurate data sets leading to skewed insights. While text-based data analysis platforms may suffer from accuracy and bias issues as NLP use of unstructured data may only sometimes capture the nuances of language and context accurately. Our exploration shows an increasing trend of platforms that try to deal with information holistically and comprehensively; we highlighted only a few selected ones. We acknowledge these platforms as relevant examples for our system development to aid our synthesis research. Analysing these platforms shed light on challenges regarding knowledge structuring in sustainable urban development and existing technical solutions that can be used and incorporated into such a system.

3 Approach

3.1 Conceptual Design of the Knowledge Synthesizer

Based on the premise that technology and science are vital to enable sustainable transition, we put forward the concept of a" virtual thinking space" that provides a comprehensive visual representation of data from the SURE funding priority, projects and synthesis findings of dormant knowledge and topics in sustainable urban regions from Southeast Asia and China. As a point of departure, the idea of the synthesizer has served as a heuristic device to access, structure, and shape bodies of knowledge actively. Relating to general information and knowledge processing principles as well as platform architecture, the knowledge synthesizer represents – in the first stance – an instrument

supporting the generation of meaningful insights about and from the SURE FSR. It does so by processing knowledge output from various inputs through functional modules of knowledge harvesting, structuring, analysis, and representation.

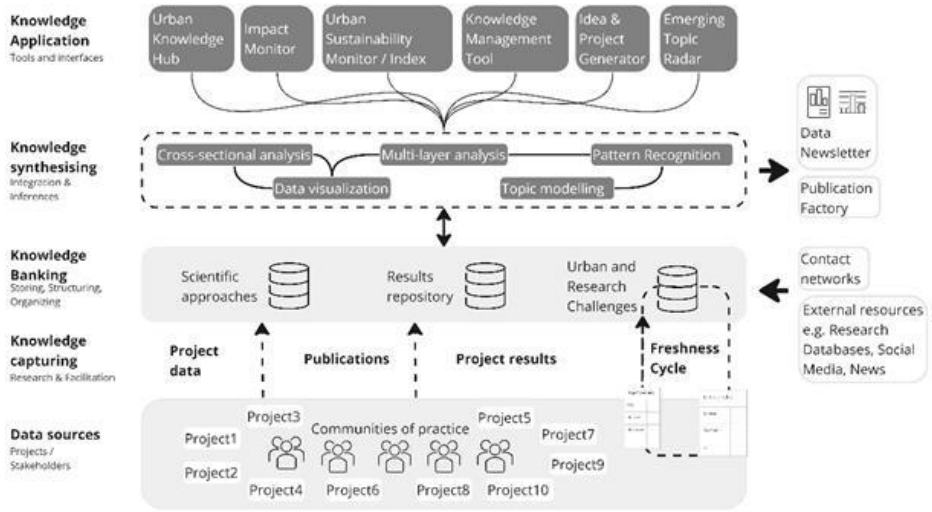

Figure 3: Maximum concept scheme of a "Knowledge Synthesizer"

Fig 2 depicts the initial conceptual design of the synthesizer – with a "Knowledge source" layer (primarily the projects facilitated by the SURE FSR), a "Knowledge collection" layer (indicating the content and input harvested and ingested in the system, e.g. qualitative and quantitative data from the research projects, their publications or through other facilitation activities, e.g. workshop, peer-to-peer meetings, project visits, interviews), and "Knowledge Banking" layer (the databases to structure, save, and make accessible the information and data gathered). A so-called "Freshness cycle" regularly updates the information and data collection as a routine task. On top of the "Knowledge Bank", the "Knowledge Synthesizer" layer processes with several "intelligent" functionalities the given input, aiming to generate new insights with the materials from the layers below. Some of these knowledge products can be automatically channelled out in the format of visual or statistic reports (e.g. "Data Newsletter"). On the top, the "Knowledge application" layer provides the specific tools and instruments to actively work and pragmatically interact with the synthetic processes and their results. This generic scheme presents a maximum concept of a "Knowledge Synthesizer" applicable to accompanying projects like SURE FSR. Given

constraints and resource limitations, this initial concept needs a reduction to a pragmatic "Minimal Viable Synthesizer" (see section 3.2). However, the modular nature of this initial conceptual design provides for continuous extension and potential upgrades in future versions. Later editions of the synthesizer may incrementally scale up functionalities.

3.2 System architecture – Minimal Viable Synthesizer

The specific system architecture of the Minimal Viable Synthesizer derives from requisite key functionalities and components needed to carry out the SURE projects and programme synthesis, impact monitoring and decision support. From the primary activities of the SURE FSR team – data linkage, statistical evaluations, thematic analyses, identification of topic networks, trend analyses etc. – the required functional layers for the Synthesizer can be determined. To access and explore SURE data efficiently, a number of databases (e.g. for project results, documents and contacts) and data services (e.g. for knowledge management, communication, and collaboration support) need to be provided. User-friendly interfaces are to present the knowledge output and gained insights – here, existing solutions from the realm of business intelligence (project dashboards, monitors, interactive cockpits) may be used. The system architecture thus comprises three main component layers (see fig. 3 "System architecture of the Minimal Viable Synthesiser: Functional layers and modules"):

- Data storage (data management, database, data lake, processing flows)
- Applications (intelligent processes and tools)
- User interface (single / multi-user, web-based, on-premise).

As input, the system gathers quantitative and qualitative data, scientific and non-scientific information from multiple sources such as projects, relevant organisations, the internet, social media, or the collaborative platform SURExCHANGE.

As SURE covers a wide range of domains, good data management and organisation are required to enable a subsequent systematisation and integration of knowledge and to discover concepts hidden in the data. The data storage and management layer collects, stores, and organises the generated and used data within the SURE framework. The layer includes a database and data lake optimised for fast queries, efficient data retrieval, and handling large volumes of data. It also ensures data accuracy and integrity through appropriate data validation and quality control measures.

The application layer comprises modules for processing user requests and generating responses based on the data stored in the database. Key applications are topic modelling, content comparison, results synthesis, and thematic clustering of solutions. Three specific functional modules are foreseen for the Minimal Viable Synthesizer: 1) a synthesis assistant, 2) an impact monitor and 3) a decision-support tool.

The interface layer provides user-friendly front-ends for accessing, exploring and interacting with the data, e.g. a web-based interface optimised for desktop and mobile devices or a stand-alone application designed for touch tables. To break down the complexity of SURE´s topics, rich and intuitive user experiences are envisioned using interactive visualisations and animations.

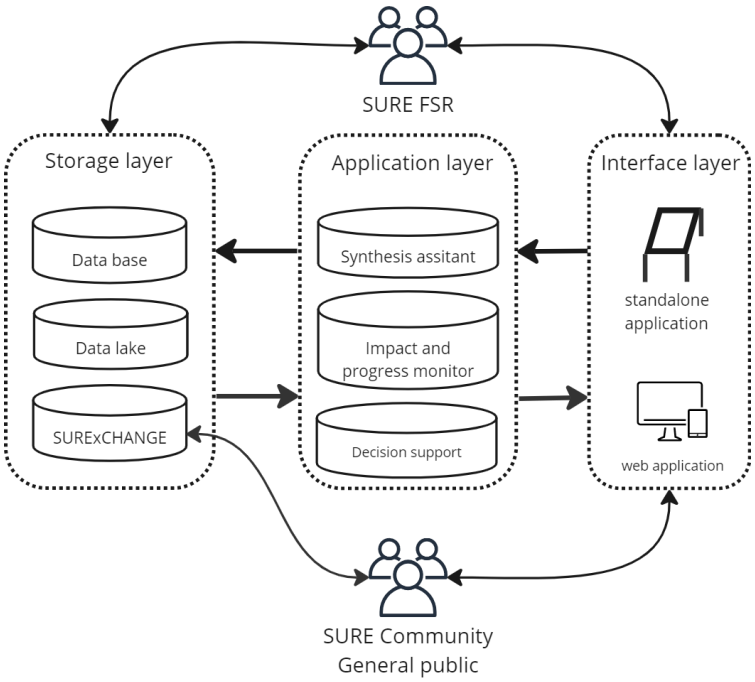

Figure 4 System architecture of the Minimal Viable Synthesiser: Functional layers and modules

3.3 Development Process of the Applications

The development process for the specific applications runs through stages of requirements definition, technical design and implementation, testing and deployment. An agile methodology is used to develop and implement all the modules, collaborate closely with stakeholders, and continuously improve the

applications at every development step. This agile process is essential for creating a synthesizer that meets user requirements and expectations while ensuring that it is stable, secure, and effective.

The first step of the agile process identifies user needs and lines out concrete use cases. Collaborative workshops with the project partners and the funding agency help to outline detailed "User Stories". So far, internal workshops have been conducted in the SURE FSR to map research needs (use cases) and identify objectives for module development. From the gathered requirements, clear and detailed design objectives and module specifications can be derived, enabling an in-depth design of the applications and functionalities in the following step, leading to a comprehensive system architecture and interface design. The technical implementation of the IT solution is followed by comprehensive testing in the next stage, where the application is thoroughly checked for mistakes and errors – first internally with the SURE FSR team and later by the entire SURE community through interactive workshops.

As a pivotal functionality to uncover and map the implicit (cross-cultural) knowledge within the SURE framework, to conduct cross-project content analysis and aid the synthesis research activities, an **NLP (Natural Language Processing) module** is envisioned. In the first stage, the NLP module will validate the list of synthetic focus topics the SURE FSR team has set up early in the project. The exploration aims to understand the text analysis and topic modelling of NLP models and train them for sustainable urban development issues. After refinement, the NLP application will assist in uncovering dormant knowledge ("Unknown Knowns"), identify open questions and problems ("Known Unknowns") and validate initial synthesis findings. The NLP module and first preliminary findings are described in more detail in a parallel paper handed in for this conference (Patel et al., 2023).

Next to the NLP module, an **Interactive Data Cockpit** is envisioned, allowing practical data exploration of the SURE funding priority. In the upcoming months, requirements-gathering workshops will be carried out with project partners and stakeholders to identify more modules to be implemented, such as a **Trend Visualiser** highlighting future development pathways or an **Impact Monitor** indicating the actual effect that SURE projects unfold in their specific context. The latter is based on the SURE Reference Picture developed by the SURE FSR partners at the Technical University of Lubeck (IFKAD23 contribution 209).

4 Conclusions

The SURE Knowledge Synthesizer is the **first conceptual and technical approach** to the ongoing challenge of integrating research findings in complex settings for urban sustainability research and to enable foresight on upcoming trends. The paper presented a conceptual design and system architecture for a Minimal Viable Synthesizer that responds to the essential requirements and functional demands deriving from such tasks. Being an ambitious venture in IT development and software configuration, however, the first technology mappings and technical explorations carried out by the FSR team suggest that solutions exist already that can effectively support knowledge management and decision-making processes in the context of sustainable urban development and policy making. Building upon existing solutions and using technology-assisted new methods and practices can facilitate the analysis and synthesis of the substantial data pool generated in sustainable urban development programmes like SURE. However, more intricate integration and in-depth research are needed to enable comprehensive knowledge synthesis in transdisciplinary urban sustainability research. On the path towards developing effective knowledge synthesis methods, the SURE FSR team acknowledges the challenges related to information organization and synthesis within an extensive research programme like SURE.

One of the significant challenges is to reduce complexity on the one hand while maintaining specificity and locality on the other. Regarding the SURE collaborative projects, region-specific topics (risk and flood management, nature-based solutions, urban planning) and culture-specific aspects remain prominent and versatile. In the process of Minimal Viable Synthesiser design, it is crucial that these aspects are reflected, and relatability by various groups of stakeholders is questioned - how to create a versatile and relatable system and generate reusable knowledge?

While the initial findings of the NLP module suggest its growing applicability in transdisciplinary research settings, the SURE FSR´s direct project interactions have uncovered the vast tacit knowledge and the eminent influence of cross-cultural sensitivity. While such aspects are difficult to grasp with technological means such as the proposed synthesizer, they still form an essential part of the SURE projects and programme. They lead to a discussion on how far tacit knowledge can be mapped, measured, and translated into tangible, transferable knowledge. For an adequate analysis of program documents and project content, recalibration of funding and proposal evaluation criteria, and improvement research policy-making, further research of respective tools and methods are needed. By

exploring, testing and validating new synthesis methods, the modular synthesizer with functionalities such as the project content analyser or topic modeller may be a first step in such direction. Taking a tentative and systemic approach may uncover step-by-step the dormant knowledge and the future topics and challenges for sustainable urban research that is being inscribed in the SURE funding priority and projects already now.

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The Creative Process Towards a Smart and Sustainable City Strategy: The Dresden Case

Jörg Rainer Noennig*

WISSENSARCHITEKTUR Laboratory of Knowledge Architecture, TU Dresden, 01062 Dresden; Digital City Science, HafenCity University Hamburg

Filipe Mello Rose

WISSENSARCHITEKTUR Laboratory of Knowledge Architecture, TU Dresden, 01062 Dresden

Paul Stadelhofer

WISSENSARCHITEKTUR Laboratory of Knowledge Architecture, TU Dresden, 01062 Dresden

Anja Jannack

WISSENSARCHITEKTUR Laboratory of Knowledge Architecture, TU Dresden, 01062 Dresden

Swati Kulashri

WISSENSARCHITEKTUR Laboratory of Knowledge Architecture, TU Dresden, 01062 Dresden

** Corresponding author*

Abstract

This paper discusses the co-creation process that led to Dresden city's smart city strategy, channelling the contributions from various stakeholder groups – politics, administration, science, civil society, and industries – into one vision for integrated and sustainable digitalisation-based urban development. This co-creative strategy process aims to overcome technology-centred smart city approaches that often fall short of generating public value, and therefore lack of public support.

As part of the federal funding priority "Model Projects Smart Cities", Dresden's municipal administration and members of the Technical University Dresden started a 1-year strategy creation phase in 2021. The resulting smart city strategy forms the basis for a subsequent 4-year implementation phase during which specific measures and projects work towards an overall smart city vision. To this end, the strategy phase had to result in a

comprehensive innovation agenda for transforming Dresden towards a smart and sustainable city (i.e., Dresden's smart city strategy). Moreover, Dresden´s application for the federal smart city programme centres on providing digital solutions to neighbourhoods to invigorate the urban society and locally create new qualities for living and working. Pursuing this goal requires a comprehensive strategy based on local stakeholders' needs and resources.
In the project's first step – the strategy phase – we devised a novel co-creative process that integrated approaches from innovation and creativity management ("Double diamond"), participation and co-creation research ("Quadruple helix"), as well as IT and software development ("Agility") into one methodology. This new approach effectively guided the strategy-making process from a comprehensive status quo analysis through creative "visioneering" towards an outline of strategic fields of action and specific measures. By combining these approaches, we ensured a dynamic, iterative process that a) effectively involves all relevant stakeholder groups, b) resulted in innovative concepts and implementation measures, and c) created a robust onward momentum leading to a feasible and context-sensitive urban development strategy in a short time.

Keywords – Smart City, Strategy Process, Participation, Urban Innovation

Paper type – Project Report

1 Introduction

Over the past decade, smart cities have become an increasingly prominent topic in urban development. Administrations and governments are pursuing the development of "smart" cities on global, national and local levels. Many countries, e.g., China, India, and the USA, have set up large-scale (funding) programs to use the opportunities of digital technologies in the urban realm.

However, during the decades since the concept's emergence, smart city development has been the target of substantial criticism. This criticism focuses on the corporate supply push by tech enterprises like IBM or Cisco, which was instrumental in creating the smart city concept and a comprehensive, fast-evolving and growing market of urban technologies (Kustra et al. 2017). However, while the corporate supply push in smart city development ensured economic value creation, these actors still face difficulties in implementing the smart city concept in ways that ensure the creation of public value (Kitchin 2014, Mello Rose 2022).

In Germany, this unclear generation of value for civil society and public sector actors and a lack of public support resulted in a feeble adoption of smart city concepts. Therefore, focussed research into the current development of smart cities is necessary to overcome the barriers to adopting smart city concepts.

In response, Germany's federal government initiated the funding priority "Model Projects Smart Cities"[1] (henceforth MPSC). This programme aims to support smart city development by focussing on urban planning and socio-spatial perspectives rather than technology-centred approaches. Furthermore, the MPSC in general, and its implementation in Dresden in particular, aim to address the uncertain public value creation and lack of public support by ensuring and providing scientific accompaniment. As part of an emerging smart or digital city science, researchers closely accompany the model project to support communities, administrations, and policy-makers in their ventures into smart city development. This way, the smart city model project from Dresden provided an outstanding opportunity to develop a smart city strategy with scientific support that integrated various scientific perspectives, especially from digital urbanism.

This article reports on this science-supported development of Dresden´s smart city strategy. The "smart city strategy" is the primary outcome of the first phase of the city's smart city model project. As an official policy document, however, the strategy leaves little room for academic reflections on its conceptual and methodological basis. This article thus aims to provide the necessary academic description and reflection to support smart city developments. We do this by presenting and discussing the strategy process´ conceptual and methodological building blocks (and their synergies) designed to overcome the barriers for creating public value and societal support in smart city developments.

2 Background

2.1 The Funding Priority "Model Projects Smart Cities" in Germany

In 2019 the German Federal Government started the funding priority "Model Projects Smart Cities" to strategically support municipalities in using digital transformation for more integrated, sustainable and welfare-oriented urban development. The framework supports cities and municipalities in testing cross-sector digital strategies and exploring role models for distinct "Smart Cities made in Germany". In contrast to previous technology and infrastructure-driven missions, e.g., in China or India, the German programme aims to highlight and shape the spatial impacts of digitalisation on local, urban and regional scales. The funded projects are to show how the social-spatial qualities of the historical European city may be transferred to the age of digitisation. The future smart cities

[1] *https://www.smart-city-dialog.de/modellprojekte*

should fully exploit all the opportunities of information and network technologies for sustainable and integrated urban development while preserving the current qualities of compact, culturally rich and human-centered cityscapes.

Organised into three cohorts that started in a yearly rhythm, 73 model projects have been selected for the funding of a total of 820 million euros from the German federal government. Applicants needed to be municipalities – the funding programme thus attained an inclination towards city administrations. Explicitly named "model projects", the supported ventures are supposed to have exemplary and replicative character. Running through a 1-year strategy phase and then through a 4-year implementation phase, they are supposed to inspire and lead a larger number of following cities in the future. The later reproduction of developed smart city strategies, measures, and solutions is built-in into the logic of each model project.

2.2 The Dresden Smart City Model Project

The application of the city of Dresden – capital of the federal state of Saxony – was selected in July 2021 for funding within the third cohort.[1] The successful project proposal titled "IQ - Intelligent Quarters" was co-authored by Dresden´s municipal IT service provider Eigenbetrieb IT-Dienstleistungen (EBIT) in cooperation with our research unit at TU Dresden, the WISSENSARCHITEKTUR Laboratory of Knowledge Architecture. The basic idea for the proposal was to offer innovative digital services and solutions in city districts and neighbourhoods that would invigorate the urban society and create new urban qualities for living and working in the immediate spatial environment. On that premises the overall goal of our model project for a Smart City "made in Dresden" is to provide sustainable impetus for the long-term improvement of the socio-spatial conditions in the city and thus become a model for other municipalities in Germany and beyond.

At the beginning of 2022, we activated the first phase – "Strategy" – which concluded in spring 2023. The main target in the strategy phase was to translate the initial vision of a city composed of intelligent quarters and districts into an overarching strategic concept. This concept would serve as a long-term guideline for implementing specific projects in the subsequent 4-year phase until 2026.

The development of the strategy demanded input and broad participation of the city administration, civil society, science and business. To this end, we

[1] *https://www.smart-city-dialog.de/modellprojekte/smart-city-modellprojekt-dresden*

designed a novel strategy process that systematically led from a comprehensive status quo analysis to formulating a general vision and strategic goals. From here, we could derive concrete missions, action plans and measurements.

3 State of the Art

3.1 Urban development strategies and Guidelines

While tackling the relatively new challenge of urban digitalisation, any new smart city strategy needs to acknowledge existing and well-established frameworks for strategic urban development on which – in most cases – the long-term planning activities of cities are based. Without attempting to present a comprehensive literature review, however, the following paragraphs introduce the relevant frameworks and discourses in the German context.

On a most general level, the **Sustainable Development Goals** (SDGs) – namely goal 11 "Liveable Cities" – provide an overarching guideline and orientation for city planning (United Nations 2015). When the SDGs were formulated, however, the trend towards smart and digital cities was just gaining momentum. Thus, the original SDGs do not precisely reflect the role of digitalisation for urbanity (later editions and amendments tried to compensate that deficit). Still, the SDGs provide a holistic framework for the goal of strategically using the power of digital transformation for sustainable development.

On the European level, the **Leipzig Charter** established in 2007 and reviewed in 2020 (BBSR Bundesinstitut für Bau-, Stadt- und Raumforschung [Federal Institute for Research on Building, Urban Affairs and Spatial Development] 2021) provides a normative framework that aims to steer urban development towards the specific social and spatial qualities of the "European City" (e.g. centrality, diversity, preservation of cultural and historical assets). However, this charter does not relate specifically to smart or digital city discourses too.

As a key instrument for the coordination of plans addressing the various urban systems, **Integrated Urban Development Concepts** (IUDCs) have been established over the past decades (BMVBS Bundesministerium für Verkehr, Bau und Stadtentwicklung [Federal Ministry of Transport, Building and Urban Affairs] 2007). Based on participatory and deliberative approaches with multiple stakeholder groups, usually created and adapted in iterative loops over the years with a broad landscape of stakeholders, IUDCs do not methodologically reflect the advent and impact of smart and digital cities. Their approaches are, to a large extent, agnostic to digitalisation and new urban technologies. While envisioning

future scenarios is undoubtedly the overall goal of IUDCs, their focus is on integrating and re-framing *existing* concepts and strategies within a unified larger picture (DST Deutscher Städtetag [German Association of Cities and Towns] 2015; BMUB Bundesministeriums für Umwelt, Naturschutz, Bau und Reaktorsicherheit [Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety] 2016).

Acknowledging the growing demand for future scenarios with less path dependence on previous planning frameworks, the German government took a more vision-oriented approach with the large-scale program and competition titled "**Future City" (Zukunftsstadt)** (BMBF Bundesministerium für Bildung und Forschung [Federal Ministry of Education and Research] 2015-2022). While supporting exploratory experiments, living lab approaches and radically new forms of citizen engagement and participation, the program did not explicitly address digital urban challenges as well (Noennig et al. 2016).

In an attempt to relate future urban development strategies stronger to the ongoing digital transformation, the German federal government initiated a counselling process, eventually leading to the national **Smart City Charter** in 2017, which was subsequently updated (BBSR Bundesinstitut für Bau-, Stadt- und Raumforschung [Federal Institute for Research on Building, Urban Affairs and Spatial Development] 2021). The charter forms a fundamental guideline for future smart city funding priorities, innovation programs, and research projects to be implemented in Germany. While the Smart City Charter included and furthered key aspects of the SDGs or the Leipzig Charter (e.g., participatory approaches, urban sustainability measures), the practical value for guiding the implementation of smart city concepts and digital urban technologies is limited.

The initiative **"City of Tomorrow" (Morgenstadt)**, run by the Fraunhofer Society since 2012, has assembled a range of companies, research institutions, and cities to build, explore, and experiment with platforms for digital urban technologies. Although multiple (not only German) cities joined the initiative, the initiative is shaped by a technology- and market-driven approach, rather focusing on urban performance indicators than socio-spatial qualities (Fraunhofer IAO 2016).

Being one of the first explicit digital city initiatives on federal level, the German government initiated the project **"Shaping the Digital City"** (Die digitale Stadt gestalten) from 2019-2022 to enable municipalities to create their digital city strategies and to set the stage for an upcoming, large-scale smart city funding priority. As a main outcome, the project issued a methodological guideline

supporting urban administrations struggling with making smart city strategies – a generic development process leaning on agile and participatory approaches (Jonas et al. 2021; Humann et al. 2022).

With a duration until 2027 at least, the German government finally started its own smart cities mission with the funding priority **"Model Projects Smart City"** in 2019, as introduced already in the previous chapter. It forms the main background for writing the smart city strategy for Dresden and, thus, for the present paper. To support and monitor the 73 individual model projects and to facilitate the knowledge exchange and technology transfer in the mission, a so-called Coordination and Transfer Agency ("Koordinierungs- und Transferstelle") was established[1]. This agency forms the focus point and synthesiser for all relevant knowledge created in the ongoing German smart city model project, especially newly minted smart city strategies and the processes leading to them.

3.2 Gaps and Challenges for Smart City Research

The previous paragraphs made clear that for the creation of smart city strategies, reliable frameworks are rare (Bauriedl & Strüver 2018). The digital revolution, on the one hand, progresses with high speed, making it difficult to catch up with normative guidelines or rules – so new developments may have easily surpassed any current state-of-the-art. The dynamics, effects and impacts of smart technologies, on the other hand, are especially hard to grasp and difficult to translate into conventional planning measures (Hick et al. 2018; Stelzle et al. 2021). This puts cities and communities under pressure when defining their attitudes and pathways towards digitalisation. Therefore, reliable strategic processes that can grasp the urban and spatial dynamics of digitalisation are in high demand (Noennig et al. 2016; Noennig et al. 2019).

Well-established frameworks fall short either by having few visionary components (as is the case with IUDCs) or by lacking orientation towards digital cities (Future Cities program). Business-oriented programs like the Morgenstadt initiative rather target corporate marketing and technological innovation than comprehensive urban development strategies with an all-inclusive societal and environmental point of view (Hick et al. 2019).

The co-creation of comprehensive strategies for a high-tech-related topic like smart or digital city development is hard to carry out with multiple players in urban administrations and civil society. The required level of technical knowledge

[1] *https://www.smart-city-dialog.de/modellprojekte/koordinierungs-und-transferstelle-modellprojekte-smart-cities-kts*

and the fast evolution of solutions make it hard to involve stakeholder groups who are not tech-affine – despite the availability of far-reaching digital media and instruments for digital participation (Münster et al. 2017; Kelber et al. 2019a).

Another main condition for the difficulty of creating smart city strategies is the absence of dedicated scientific research. Only a few authors systematically propose and discuss the practical steps for strategy development of digital cities (Piskorek et al. 2015; Schwegmann et al. 2021; Noennig et al. 2022). Although thorough reflection and critical discourses accompany the swift technological innovation of new urban technologies, methodologies and instruments are yet missing for the proactive and prospective planning of smart cities (Bauriedl & Strüver 2018). Notably, there is no well-established and reliable design science to target the digital urban transformation, or to strategically shape smart technologies for urban development. Moreover, existing smart city research rarely takes a planning perspective. As a result, participatory and co-creative methodologies – sufficiently complex enough already in the context of conventional urban planning – are lagging far behind in the case of smart city development.

4 Idea and Approach

4.1 Ambition

Acknowledging the demand for a systematic and scientific approach, the overall process towards Dresden´s smart city strategy benefited from the specific opportunity that our research unit at TU Dresden – the Knowledge Architecture Lab – could provide scientific and methodological expertise not only in the field of strategic and integrated urban development but also in smart city technologies (Stelzle et al. 2017; Kelber at al. 2019b; Jannack et al. 2020). Targeting a process built upon the scientific state-of-the-art, the project leader at the City´s IT Services Agency (EBIT) assigned the responsibility for the strategy development to our lab. By the end of the first project phase, a feasible, concise and context-sensitive smart city strategy was expected that would be yet open for further development and improvement in subsequent implementation phase. More specifically, the ambition was to devise a strategy-making process that would

- ensure the creation of innovative concepts and measures,
- effectively involve all relevant stakeholder groups,
- maintain a strong onward momentum and intrinsic dynamics.

Given the complexity of the tasks and ambition (e.g., dozens of administrative units had to be involved), the pre-defined 12 months timespan for the strategy-making was very short (eventually, the funding agency recognised this shortcoming and extended the strategy phase by half a year).

4.2 Designing an Integrated Process

To achieve the above-mentioned targets, we envisioned a strategy-making process integrating elements from innovation and creativity management, participation and co-creation research, as well as IT/software development. By combining these approaches, we wanted to ensure that, on the one hand, a comprehensive involvement of all groups would be guaranteed and citizen-oriented, user-friendly solutions be created. On the other hand, we aimed to facilitate the creation of novel and ambitious ideas that could be further developed and improved in the later process. Specifically, we combined the following three approaches (Fig. 1):



Figure 1: Conceptual approaches for the smart city strategy process: Double Diamond, Agility, and Quadruple Helix. (Source: TU Dresden)

The *Double Diamond* from design thinking is a creative process that leads through successive divergence and convergence phases from the problem definition to the development of ideas to the creation of prototypes (Banathy 1996).

The principle of *Agility* from IT and software development describes an iterative step-by-step approach in which requirements and solutions are flexibly adapted in the continuous exchange between developers and customers to be able to react quickly to changes (Beck et al. 2001).

The *Quadruple Helix* from innovation and participation research supports the cooperation between four actor types – politics/administration, civil society, business and science – to make innovations economically, socially and ecologically sustainable (Carayannis & Campbell 2009).

Based on previous experiences in designing processes for citizen participation, we integrated these well-known components into a lean yet viable procedure

(Stelzle et al. 2020). We conceptualised a framework that followed the standard steps of most strategy-making approaches (status quo analysis · future vision · implementation roadmap). A new component, however, was to form a "driver" for the strategy process from those partners in the municipal administration (EBIT) and science (TU Dresden) who had been responsible for the project application – and were thus well acquainted not only with each other but also with the conditions of the funding program and relevant political smart city frameworks. Moreover, this "driver" team would bring a natural interest in furthering the project they themselves had initiated before. This dynamic momentum from this "driver" is represented in Fig. 2 by the horizontal grey arrow.

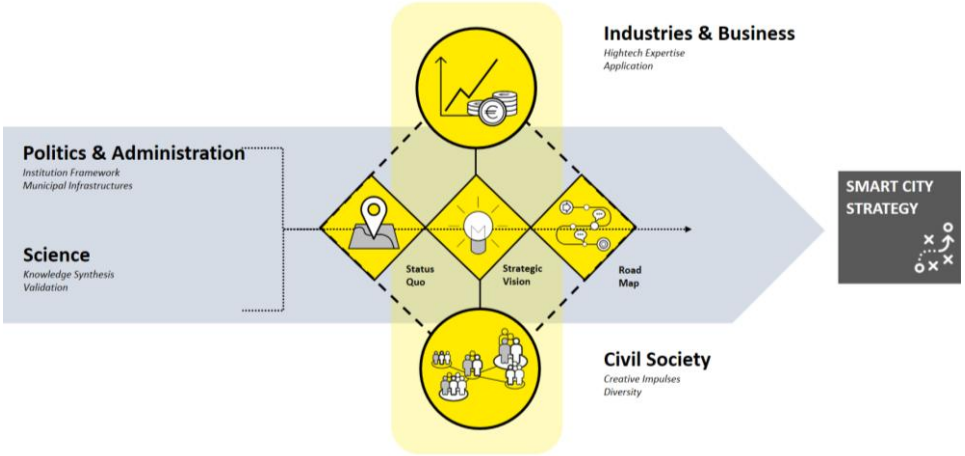

Figure 2: Procedural scheme #1 towards the Smart City Strategy: Onwards-moving "driver" (horizontal arrow) plus broader stakeholder participation (vertical bar). (Source: TU Dresden)

We acknowledged clearly that the complex and far-reaching strategy process needed broad participation and involvement of various stakeholder groups. Thus we completed the procedural scheme with a second lateral momentum (vertical yellow bar) which was supposed to introduce all relevant aspects "from the side" – that is: from civil society (individual persons but also organisations, associations, initiatives etc.) as well as from industries and business. From both sides, we expected valuable inputs and inspirations for the overall process.

While Fig. 2 – drawn early in the project's first phase – gave us a guideline and orientation for the design of the overall procedure, the actual process eventually looked much different. Fig. 3 shows the process diagram as conceived at the end of the strategy phase. While the key conceptual elements (Double Diamond, Agility, and Quadruple Helix) remain discernible, the onward momentum

unfolded through complex and somewhat diffuse feedback/forward loops. They represent the necessary iterative cycles that concepts must pass to receive (in)formal acceptance, e.g., in bureaucratic admissions or public communication campaigns.

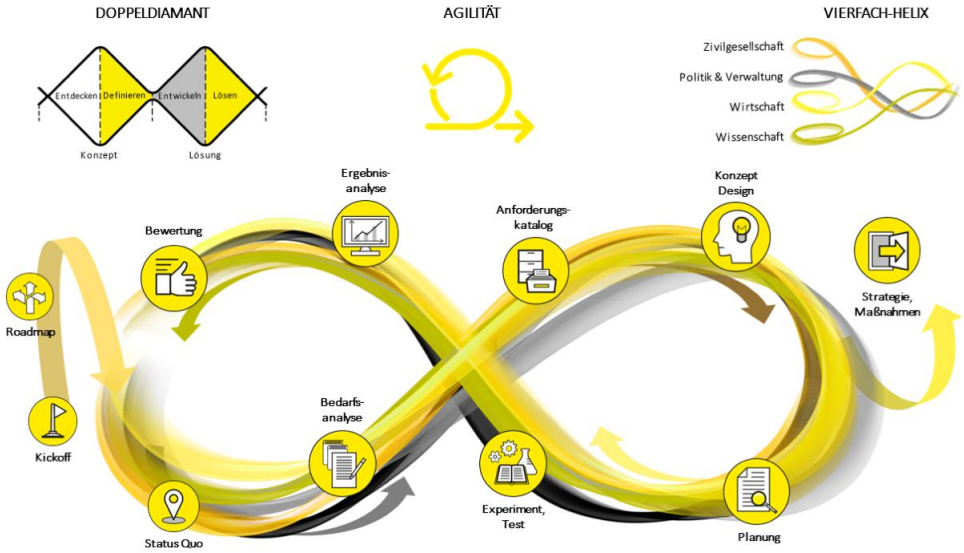

Figure 3: Procedural scheme #2: A complex and dynamic process based on iterative feedback/forward loops and defined milestones (Source: TU Dresden).

4.3 Roadmap for Strategy Making

The pragmatic implementation of this scheme and the multiple activities that it embraces resulted in a roadmap comprising multiple activities and events, especially participation formats. Fig. 4 shows the respective milestones that span from so-called first-hand data-collection with mayors and high-level deputies ("Leitplanken-Interviews") to online participation campaigns ("Smart City Survey"), from in-depth workshops with research institutions ("Ecological Spatial Development") to public promotions events (e.g. "Science Night").

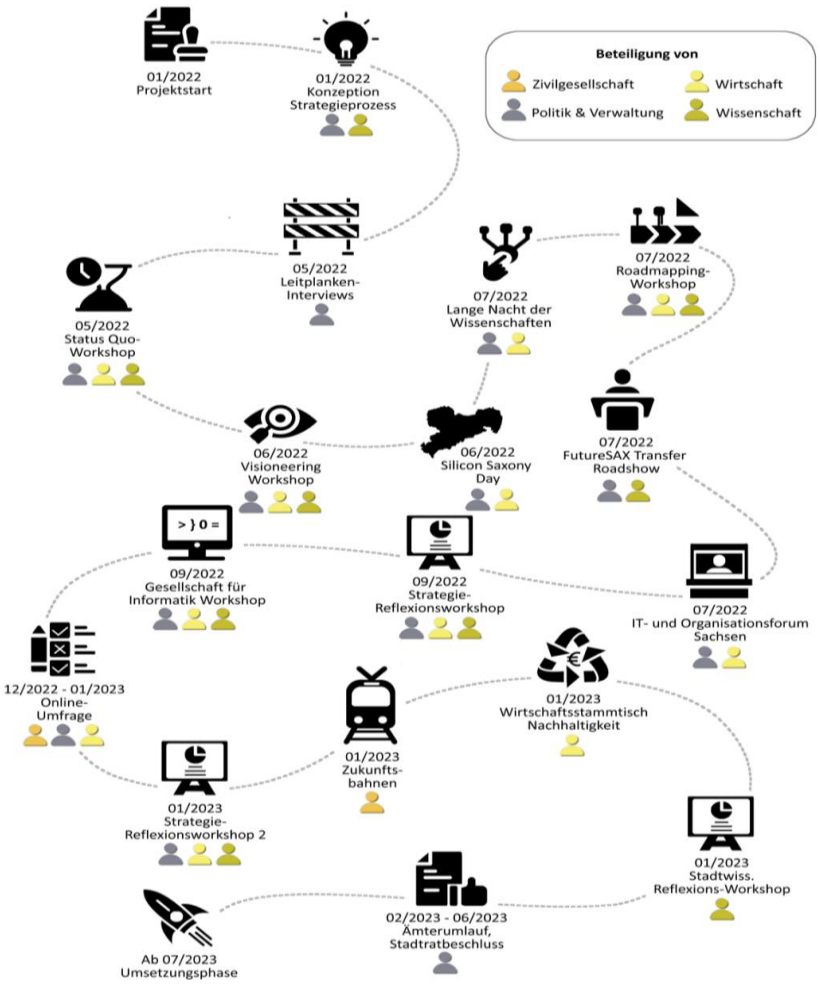

Figure 4: Roadmap through the strategy phase: Participatory events and activities with different stakeholder groups and actors. (Source: TU Dresden)

The intention of rolling out such a range of participation formats was to involve as broadly as possible the various stakeholder groups, to compensate the shortcomings of the single measures by the multiplicity and diversity of formats, and to collect thorough and deep knowledge about smart city projects and processes (impacts, risks, potential threats). While the temporal compression and partial parallelism of events were a challenge, the complementarity of formats and the respective findings ushered in surprising results (see section V).

4.4 Participation in Smart City Strategy Making

Appropriate involvement of the various stakeholder groups – especially the civil society – was a quality demand stated by not only the funding programme but also by previous research (Stelzle et al. 2017; Stelzle & Noennig 2019). Hence, after co-creating initial ideas with experts from urban politics, administration, science and civil society in participatory strategy workshops, we enhanced these inputs at the end of 2022 / beginning of 2023 through various public participation campaigns and expert talks with representatives from the science and business sphere. In these formats, already running measures as well as existing thematic approaches relevant for the smart city context had been reviewed and checked for their potential to integrate into the model project. The goal was to create the most comprehensive possible synergies between the diversity of activities and actors, and to support the achievement of the city´s overarching development goals.



Figure 5: "Zukunftsbahn" – Future Tram – ad hoc participation in public transportation. Tram lines become mobile laboratories for citizen engagement. (Source: TU Dresden

In order to understand the tonality and attitude of the citizenship towards the idea of a smart city in general, and a Dresden-tailored strategy specifically, we engaged citizens by formats like the "Future Tram" (Zukunftsbahn) for which we remodelled public streetcars into rolling co-creation labs ("participation on wheels", Fig. 5) – or via an extensive online campaign. Based on previous research of "crowd listening" and discourse analysis (Holmer & Noennig 2017, 2018), the thorough analysis and synthesis of the results provided important guidance for the further design of the strategic process.

5 Results Discussion

As we accomplished the process of creating Dresden´s Smart City Strategy in spring 2023, we cannot yet report on the strategy's long-term effects and impacts on the city's overall urban development and its neighbourhoods. However, the process itself and its key results allow first assessment, reflection and criticism.

5.1 Assessment of the Strategic Process

In the relatively short period of one year, the strategy team initiated, carried out and concluded a comprehensive strategic process based on a complex set of co-creative activities for a broad range of stakeholders. The effort finally led to a smart city strategy that was documented in two formats – a 70-page long version, from which a 15-page executive summary was condensed. Besides a comprehensive digest of the status quo analysis, the strategy includes a key vision ("mantra"), four overarching fields of activity, and nine specific measures and projects to be implemented in the subsequent 4-year project phase.

Due to lacking research and reliable methodologies (as described before), the overall process appeared somewhat obscure at the outset but soon consolidated into defined activities, formats, and results. We have successfully tested three key approaches that bear the potential to become part of a replicable model process:

1. The design and implementation of a set of **complementary participation measures,** targeting topics of smart city development and involving various stakeholder groups – to consolidate the local status quo as well as to collect creative input and critical feedback for the envisioned future strategy;
2. The conduct of a **complex concept synthesis,** mainly carried by the researchers at TU Dresden, who were in charge of streamlining and shaping the various stakeholder inputs into a concise vision picture and defined fields of activity by way of topic modelling and synthesis workshops;
3. The facilitation of a **simultaneous and iterative counter flow** of high-level vision-making on the one hand – as carried out within the process by key stakeholders and the strategy team – opposed by the pragmatic definition of concrete projects on the other hand, as resulted from ongoing activities and existing demands in the city administration of Dresden.

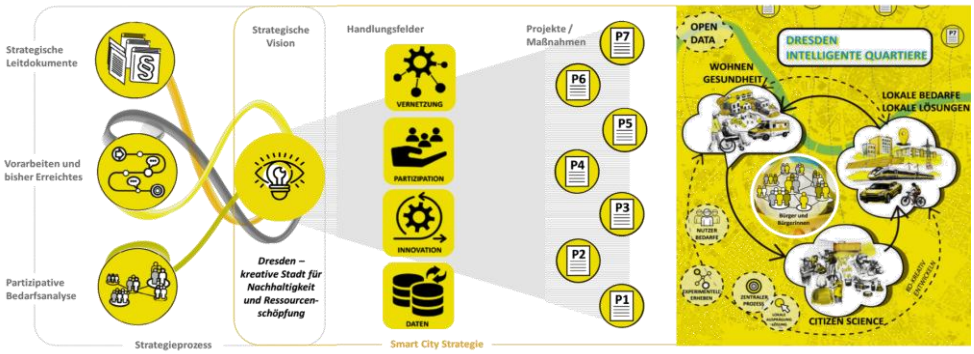

Figure 6: Counter flow of high-level strategy-making (left) and concrete implementation projects (right), connected by a strategic vision and general fields of activity (centre). (Source: TU Dresden)

To form a replicable model, we have systematised in retrospect the experimental and explorative procedure into a generic methodology (Fig. 6). It suggests a purposeful channelling of the strategic documents review, the survey of previous and ongoing local smart city activities, as well as the broad participatory demand analysis into one strategic vision (left side of the image). At the same time, concrete projects are being conceptualised for implementation in specific urban neighbourhoods (image right), feeding into overarching fields of activity (image centre) that directly support the vision.

Following the general agile approach, all past and future participants are encouraged to regard the present strategy as an open-ended, living document that demands continuous updates and revision in the future stages of the project.

5.2 Dresden-specific Results of the Strategic Process

In contrast to the presented generic process scheme, the specific results of Dresden´s smart city strategy process are location-bound and not necessarily replicable. To indicate the capacity of the new process for the specific urban development context, we will highlight some specific results in the following paragraphs.

The initial status quo analysis carried out in co-creative workshops led to a comprehensive mapping of existing smart city projects, themes, and actors (Fig. 7). Consolidated into an interactive collection of hundreds of project and institutional profiles, this so-called "Smart City Radar" provided a comprehensive knowledge base for synthesising the multitude of activities into coherent vision

and action – and will most certainly do so in the upcoming implementation phase too.

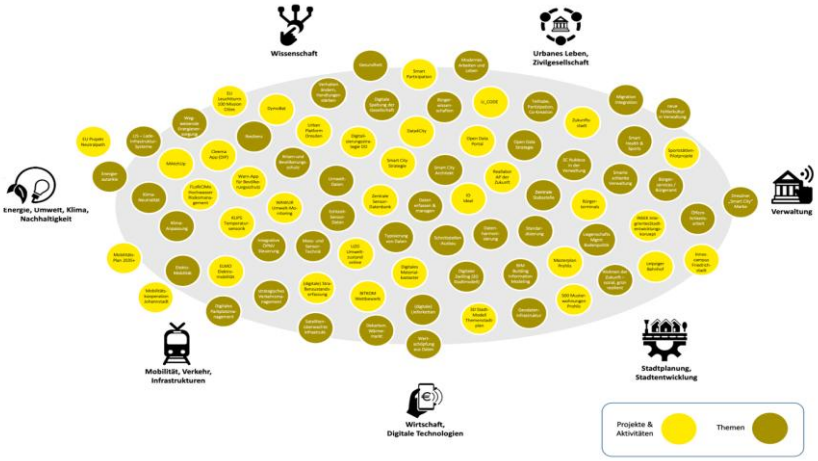

Figure 7: Smart City Radar – Visualisation of existing smart city projects (yellow) and themes (olive) in Dresden, arranged by sectors. (Source: TU Dresden).

The focus group workshops in Dresden´s so-called "Bürgerlabor" (Citizen Lab) – a public open facility on the ground floor of the town hall – brought strong conceptual impulses to feed into the later strategy process. Here, dozens of participants co-created high-flying visions ("Merging tradition and digitalisation") and mission statements ("Networking actors to facilitate a maker culture") for the long-term future, as well as ambitious challenges ("City Service Hubs") and concrete project ideas ("Open Data Access") to be tackled in the short run. These inputs have been carefully collected, synthesised and fed into the strategy activities.

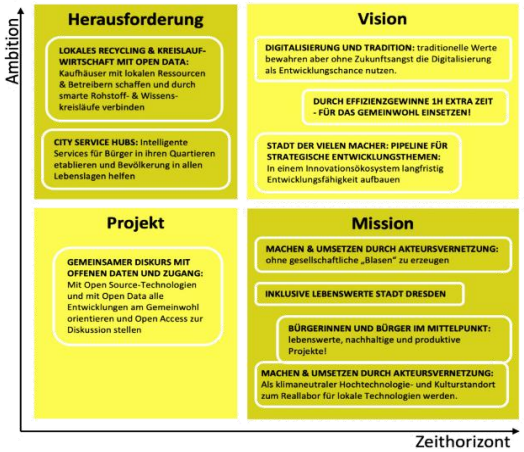

Figure 8: Matrix of co-created smart city visions / missions / challenges and projects for Dresden. (Source: TU Dresden)

The comprehensive collection of smart city challenges and demands through participatory campaigns (Future Tram, online survey) drew up an informative picture of the overall attitude of Dresden´s citizenship towards smart city themes. The online survey (Fig. 9) with more than 600 replies showed that mainly positive interpretations prevail within the population. At the same time, fears of surveillance and technocracy exist, even though they are not dominating. Meanwhile, visionary concepts co-created in participation workshops such as "Digital Service Points" or "Dresden as a testbed for innovative climate-protecting solutions" earned high agreement.

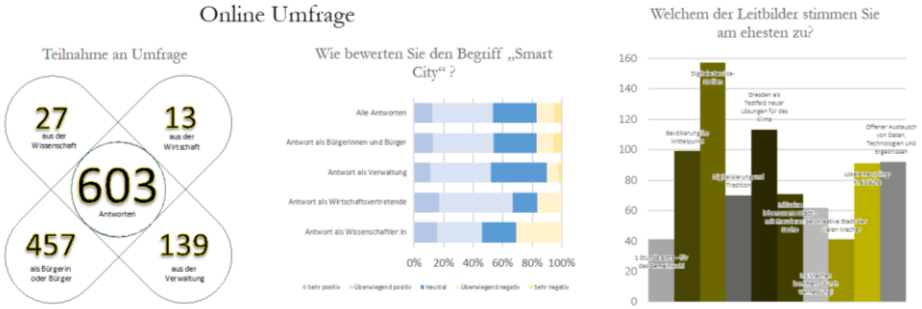

Figure 9: Results analysis of online survey: Participants count, positive/negative "Smart City" interpretation, preferred visions. (Source: TU Dresden).

The strategy process resulted in a portfolio of nine concrete projects, which – following the overall smart city strategy – are scheduled for implementation in the second phase of the model project. As thematic impulses mostly came from the city administration and authorities, their curation into coherent measures complying with the comprehensive new strategy has been a major activity throughout the strategy phase. Concrete measures include, for example, the establishment of a public platform ("Cleema App") to trigger sustainable behaviour changes in the local population (Fig. 10). Each measure was carefully assessed as to their compliance with the UN Sustainable Development Goals and the national Smart City Charter, as well as their socio-spatial impacts according to Dresden´s Integrated Urban Development Concept (IUDC).



Figure 10: Project profile for smart project to be implemented: Cleema App for triggering citizen behaviour change towards sustainability. (Source: Cleema / TU Dresden).

6 Conclusions and Outlook

Within the specific context of the smart city model project for Dresden, and with an explorative and experimental approach, we have designed and tested a new methodology for creating smart city strategies. Based on state-of-the-art research in smart and digital cities, and in line with the overall ambition of the national funding priority "Model Project Smart Cities", we have put forward a model process that appears replicable in other places too. The individual components of the process are easy to implement; local-specific adaptations are possible. The value of this process derives from the purposeful integration of conceptual key components into a co-creative logic enabling the effective formulation of strategic visions and actions.

By fusing approaches from innovation and creativity management ("Double diamond"), participation and co-creation research ("Quadruple helix"), as well as IT and software development ("Agility"), the new methodology was able to drive our strategy-making with high momentum. By combining these approaches, we ensured a dynamic process that a) involved all relevant stakeholder groups, b) resulted in innovative concepts and implementation measures, and c) created a strong forward movement that would rapidly lead to a feasible and context-sensitive urban development strategy.

Why are such strategies and visions important for smart and digital city developments? Arguably, they compensate for the high levels of insecurity that city administrations as well as civil societies face during the rapid digital transformation of their cities (Bauriedl & Strüver 2018). The opacity of urban futures creates a growing desire for normative visions. While any "future-telling" may be highly speculative by default, the outlining of strategic urban visions by way of iterative and co-creative problem-solving appears instrumental for

defining potential paths into agreeable and controllable futures. Anticipating possible future discourses and technological developments, they may become self-fulfilling prophecies.

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Unlocking the Potential of NLP in Text Data Analysis for Sustainable Urban Development

Chintan Patel*

Digital City Science, Hafencity Universität
Henning-Voscherau-Platz 1
20457 Hamburg, Germany

Mohammed Sohanur Rahman

DigitalCity Science, Hafencity Universität
Henning-Voscherau-Platz 1
20457 Hamburg, Germany

Katharina M. Borgmann

DigitalCity Science, Hafencity Universität
Henning-Voscherau-Platz 1
20457 Hamburg, Germany

Ágota Barabás

DigitalCity Science, Hafencity Universität
Henning-Voscherau-Platz 1
20457 Hamburg, Germany

Jörg R. Noennig

Digital City Science, Hafencity Universität
Henning-Voscherau-Platz 1
20457 Hamburg, Germany

** Corresponding author*

Abstract

This paper reports on results of the SURE facilitation and synthesis research (FSR) project for the funding priority SURE (Sustainable Development of Urban Regions) of the German Federal Ministry of Education and Research (BMBF). SURE engages ten collaborative projects which develop concepts and test locally implementable solutions and strategies for sustainable transformation of fast-growing urban regions in Southeast Asia and China. SURE aims to create conceptual, theoretical, methodological, and translational innovations that integrate and move beyond discipline-specific approaches to address issues of sustainable urban development. The paper discusses the application of Natural Language

Processing (NLP) as one form of Artificial Intelligence (AI) to support data and knowledge synthesis in sustainable urban development research. The abundant urban data and recent advancements in the field of AI have the potential to transform how urban researchers perceive and tackle sustainable development-related problems of cities. The research team employs various NLP algorithms to assess text data with the goal to analyse patterns in order to explore intra-project synergies and research intelligence on future trends. NLP has exhibited an ability to digest copious textual data and improve the usability of urban corpora, improving study scope and reducing resources required for research. However, the implementation of NLP to study issues related to sustainable urban development is a relatively novel. Predominantly used NLP modules are unable to identify contextual relations amongst multiple words which is essential in urban region study. To overcome this issue, algorithms employed were trained to identify various word classifications related to urban study discipline for precise output. We discuss the preliminary results of the ongoing exploration and show how it could contribute to an understanding of large text-based data sets in urban knowledge management. We examine the possibilities and limitations of such an approach and discuss the implications of AI as part of a multi-methodological approach to carry out a synthesis of sustainable urban development research efforts across an entire region covered under SURE framework. The paper also gives an outlook on utilising new AI based algorithms to generate text-based data analysis channel as well as indicate the limits, successes, challenges and constraints of such approaches.

Keywords – Sustainable Urban Development, Natural Language Processing, Artificial Intelligence, Knowledge Management

Paper type – Academic Research Paper

1 Background and Introduction

Rapidly growth of urban dwellings in cities located in South-East Asia and China has posed a challenge to scholars in dealing with complex issues threatening the societal livelihood of community and sustainable development. Researchers Kates et al. (2001), Binder et al. (2015), Zscheischler et al. (2014) discovered that dependency on inputs from single discipline is not enough to address intricate and complex problems related to sustainable development of urban and rural areas. Rather a transdisciplinary framework encompassing academics, non-academics and mutual learning amongst stakeholders is necessary to determine a practice-oriented solution that could be implemented locally. On such premise, the German Federal Ministry of Education and Research (BMBF) sponsors the funding priority SURE 'Sustainable Development of Urban Regions' that promotes transdisciplinary research towards SDG localization and an accompanying synthesis research with a primary focus to explore new

collaborative approaches that enable societal contribution, future topics and challenges in urban and rural development.

The SURE funding priority comprises ten collaborative projects oriented towards development of concepts and testing implementable solutions locally in fast-growing urban regions in Southeast Asia and China. These ten projects and funding priority are accompanied by the SURE Facilitation and Synthesis Research (SURE FSR) project that aims to create conceptual, theoretical, methodological, and translational innovations that integrate and move beyond discipline-specific approaches to address the issue of sustainable urban development. Such framework enables vast tangible and intangible knowledge generation, that is captured from project documents (e.g. proposals, reports, results) and through facilitation activities (workshops, peer-to-peer meetings, interviews) to identify transdisciplinary and sustainable urban development challenges. The SURE FSR aims for transdisciplinary knowledge synthesis in sustainable urban research, with one of its pillars being 'Research intelligence ', where the team explores the digital tools and data science approaches to establish synergies between project via content comparison, topic modelling and exploration of future trends and challenges. This paper is embedded in the larger research effort of the SURE FSR, where the knowledge is being synthesized with the employment of AI tools. The IFKAD'23 paper by Agota Barabas et al., titled *'sustainable knowledge synthesizer: a modular tool for urban research'*, from the HafenCity University Hamburg (ID 245) shows how databases, as well as data services for knowledge management and communication and collaboration, are provided, adapting solutions from business intelligence (e.g. project dashboard, monitors, cockpits), and then aggregated in the functional tool "Synthesizer". The paper discusses the concept of such a synthesizing system and its application in a meta-research environment of transdisciplinary sustainable urban development approaches, sheds light on the opportunities and challenges of the development of such a synthesizing tool, and draws a first picture of the complexity accompanying the development of a "synthesizer" as part of the SURE FSR.

Recent strides in the field of artificial intelligence (AI) and machine learning give an opportunity to analyse such tangible project outputs. AI applications has been prevalent in energy efficiency and mobility since early 2010s while recently developed AI tool's applicability in sustainability science has proven effective in various sectors including water management, sanitation, agriculture, pollution, urban development as well as tracking progress of sustainable development goals (SDGs) (Goralski & Tan, 2020; WU et al., 2022).

A sub-branch of Machine Learning, denoted as Natural Language Processing (NLP), has a capability of understanding human language structures and assist in analysing big text corpora. It is a form of computational algorithms which perform various tasks such as text analysis, text categorisation, sentiment analysis, topic modelling, network analysis, or text summarisation. In context of transdisciplinary research, NLP bears large potential to perform qualitative analyses on large volumes of data collected through interviews, focus groups, or survey responses as well as identify the main topics or themes within a large amount of text. Furthermore, NLP has wide applicability in field of sustainability research due to wide range of customisation and possibility of creating tailored neural networks in accordance to given research objectives. Such AI-assisted qualitative data analysis can help researchers identify patterns and trends that might otherwise go unnoticed, providing a more comprehensive understanding of the research topic. A bibliometric study conducted by Fosso Wamba et al., (2021) observed a significant increase in the utilisation of neural networks and other Machine Learning approaches for addressing ecosystem challenges, infrastructure management, and stakeholder management. Although trend of using AI-related tools to tackle challenges related to urban development is still in its infancy, researchers have applied NLP techniques in various topics related to urban governance and management, public health, land use and functional zones, mobility, and urban design (Cai, 2021). Li et al. (2023) demonstrated the capability of NLP using social media data to predict urban flood susceptibility in Chengdu, China; while Bardhan et al. (2019) developed a more sophisticated NLP algorithm capable of performing sentiment analysis as a mean to document various aspects in integrated urban planning of slum housing rehabilitation projects in Mumbai. Riding this wave of exploration of AI applicability relevance in area of sustainability and urban development, SURE FSR attempts to explore the sphere of content comparison and qualitative research in order to find cross-cutting topics and establish synergies between diverse topics. Exploring the applicability of AI in the area of sustainability and urban development, SURE FSR employs it for content comparison, to validate findings (e.g. focus topics), search for synergies between projects and knowledge synthesis. For this end, the SURE funding priority has been a rich source of tangible data to be analysed with NLP in order to create and test hypotheses.

2 Research Methodology

2.1 Research Objective

The SURE Facilitation and Synthesis research Project explores the challenges of synthesis research in cross-cultural settings and institutional set-ups, with a particular focus on sustainable development in the built environment in South-East Asia and China. The activity of this complex project is divided in two main "wings": facilitation and synthesis research. The approach used in the SURE Facilitation and Synthesis research project is transdisciplinary, problem-driven, and solution-oriented. The project employs a meta-study methodology that synthesizes and consolidates existing conceptual, methodological, and empirical knowledge from literature and the ten collaborative projects within the SURE funding priority. Overall, the approach used in the SURE Facilitation and Synthesis research project is designed to support individual research projects and to systematically leverage the cross-project synergy potentials at the funding priority level. The goal is to create conceptual, theoretical, methodological, and translational innovations that integrate and move beyond discipline-specific approaches to address the issue of sustainable urban development.

The project looks to synthesize and consolidate existing conceptual, methodological, and empirical knowledge from literature and the ten SURE collaborative projects. This qualitative meta-study aims to contribute to the transdisciplinary sustainable research discourse by providing a scientific contribution to the third epistemic way (Lang, Wiek et al. 2012). The research project is designed to support individual research projects on the one hand and to systematically leverage the cross-project synergy potentials at the funding priority level based on the collected and structured knowledge from the projects and beyond. Conducting meta-research across disciplines and across cultural borders requires a management of knowledge that is sensitive towards these challenges (Ioannidis, Fanelli et al. 2015). Within the SURE facilitation and synthesis research approach, we developed a research and knowledge architecture that allows for constant reflection to improve the applied concepts. The overall structure of the SURE FSR is described in more detail in the IFKAD'23 paper 'Meta-study: research architecture for sustainable knowledge synthesis' (ID 231) by Katharina M. Borgmann et al. from the HafenCity University Hamburg.

Although the funding priority targets inherently non-linear development dynamics that are difficult to capture by computation, trained algorithms still may provide a substantial support. For this reason, we put forward the concept of a

technology-aided knowledge synthesizer and outline its conceptual design and technical implementation in a parallel paper to this conference (Barabas et al., 2023). The synthesizer is conceived as a digital infrastructure for knowledge creation and decision support, based on thorough project analysis and content elaboration. Assisting with scientific classification, among others, it aims to indicate future research topics and challenges in sustainable urban development. The system's idea is rooted in knowledge theory and knowledge lifecycles models with a focus on modes of knowledge synthesis – the integration and refinement of existing knowledge into new insights. The conceptual design of the synthesizer is composed of modules for the access, structuring and integration of knowledge captured from the transdisciplinary research projects in SURE.

This paper presents an exploratory inquiry's initial findings with NLP that is part of synthesizer´s module development. This component is envisioned to conduct the cross-project content analysis and topic modelling to aid the synthesis research. Previously the SURE FSR team has synthesised and clustered without algorithmic support six focus topics based on projects and funding priority contents:

1. Urban-Rural Nexus
2. Resource Efficiency and Mitigation
3. Sustainable Behaviour and Practices
4. Ecosystem Services and Nature Based Solutions
5. Risk Management and Risk Reduction
6. Integrated Planning and Development.

Our initial exploration of NLP aims to validate these six focus topics generated in the researchers´ previous discourse, and to understand the opportunities and challenges of automated text analysis and topic modelling within the overall process of knowledge synthesis. For the validation, we included the original documents of the BMBF funding call and project proposals that were used for the initial topic synthesis. In addition, we extended the document list with relevant policy frameworks and strategy documents to generate still better results.

Albeit the investigation is still embryonic, it provides valuable insights in development of topic modelling and discovery of future trends and challenges in sustainable urban development.

Table 1: Documents included in Dataset

Name	Type	Publication Year
Project 1	Project Proposal	2017
Project 2	Project Proposal	2017
Project 3	Project Proposal	2017
Project 4	Project Proposal	2017
Project 5	Project Proposal	2017
Project 6	Project Proposal	2017
Project 7	Project Proposal	2017
Project 8	Project Proposal	2017
Project 9	Project Proposal	2017
Project 10	Project Proposal	2017
IPCC 5th Edition	International Policy Framework	2014
Paris Agreement	International Policy Framework	2015
New Urban Agenda	International Policy Framework	2016
WBGU	German Policy Framework	2016
FONA3	German Policy Framework	2016
BMBF Call	Call for Proposal	2016
FONA Strategies	German Policy Framework	2021

*Abbreviations
IPCC - *Intergovernmental Panel on Climate Change*
WBGU - *Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (German Advisory Council on Global Change)*
FONA - Forschung für Nachhaltigkeit (Sustainability Research)
BMBF - Bundesministerium für Bildung und Forschung (Federal Ministry of Education and Research)

2.1 Data – Proposals and Policies

The database of this study consists of proposals prepared by all ten projects and policies that has served as foundation for the SURE funding priority. Additionally, text extracted from webpage dedicated to all for proposals is also included in study. *Table 1* enlists documents included in analysis along with the publication years and other attributions. Due to privacy measures project names are not disclosed. The policy framework documents and SURE call for proposals are open-source and available online.

2.3 Data Preparation

Eliciting textual data and pre-processing of documents for NLP analysis is necessary to remove the irrelevant information such as headers, footers, and references along with images. While manually pre-analysing the project proposal documents, irrelevant data without objective value were omitted. They include sensitive information such as partner information, personal details along with other numerical and graphical data.

3 Data Analysis and Results

3.1 NLP Analysis

3.1.1 Document Cleaning

Fig 1 illustrates the workflow of the methodology encompassing the step-by-step process for NLP analysis. The data pre-processing and removal of sensitive data from the documents has been conducted manually without any computation, resulting in converted pdf files to ensure better accessibility across various platforms. Python is chosen as a programming language to perform the research analysis, as a significant number of open-source algorithm libraries are offered in that language that are required at various stages of research. An iterative process is required to validate and check the compatibility at each stage of such analysis to ensure the accurate extraction of the desired output. Thus, in every stage of the process represented in decision tree (*fig 1*), a compatibility check is performed to maintain the homogeneity of the data.

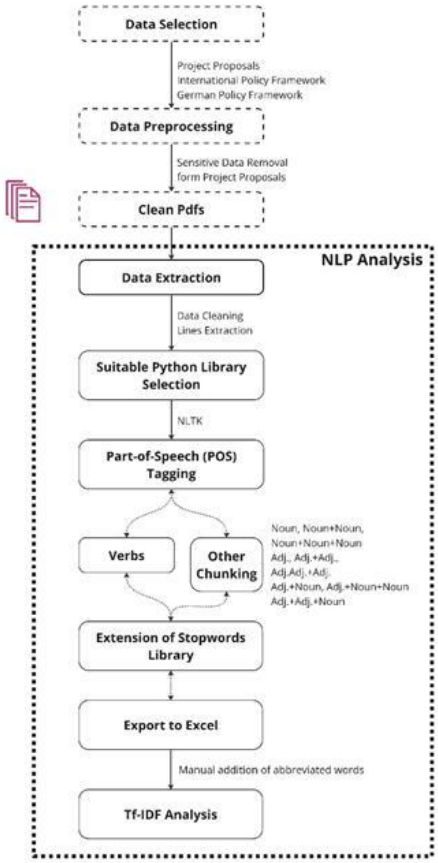

Fig 1: NLP Analysis Decision Tree

3.1.2 Approach and Customisation of the Natural Language Processing

Numerous open-source NLP libraries are available that are capable of performing basic tasks such as tokenisation, word tagging to advanced Machine Learning frameworks for natural language understanding and generation. Choosing a suitable library for required analysis could be a daunting task as these libraries offer specialised computation to perform specific tasks. Although the flexibility of Python scripts allows for the usage of multiple libraries in one algorithm, doing so also increases risk of errors and incompetence in analysis. Part-Of-Speech (POS) tagging emerged as essential process of computation from NLP analysis scope and output requirements study. One of the prominent complexities observed during an initial check is that word roots and its affixes usually hold contextually different meaning in the sentence formation of texts related to urban development and sustainability science (Jha et al., 2021). Thus, the standard linguistics processes of text lemmatisation and text stemming are

avoided in our algorithm to preserve the textual context as much as possible in NLP results. Versality of the library also emerges as a deciding factor in the selection. As this study is to serve as basis for topic modelling and future challenges predication, the chosen library should offer tools and functionality to perform tasks such as named entity reorganisation (NER), machine translation, text classification and sentiment analysis. Primary requirement for this study is to perform an extensive POS tagging and identification of n-grams variations combining noun, adjective, adverb as well as long expressions. The Natural Language Toolkit (NLTK) was chosen as primary Python library to perform task related to NLP, as it offers tools to perform the afore-mentioned requirements and ease of customisation (Bird et al., 2009). In order to extract lines and sentences from the cleaned documents, removal of punctuations and word wrapping is necessary to achieve accurate results (Goralski & Tan, 2020). Python offers various pre-programmed libraries to perform line and sentence extractions from pdf documents. After conducting an iterative process conducted on assorted libraries and respective outputs, PdfPlumber library was chosen in the further computation as it offers better functionality in processing texts from diverse sources (GitHub, 2023). Due to diversity of data, it is observed that predefined stop words and punctuations used by the library are not adequate to provide satisfying results. Therefore, additional custom punctuations (see Annex 1) are amalgamated with existing stopword directory of NLTK after iteration.

To achieve the indicated research objective and uncover potential correlation between policy frameworks and the established project purpose, the NLP algorithm was trained to identify and extract keywords from each document. A bilateral approach was integrated in the Python script to differentiate POS tagging of verbs and various combinations of nouns and adjectives. While existing studies claim to have completely replaced traditional analysis methods in few fields of urban planning, existing models available for NLP analysis of text related to sustainability and related urban development lack cohesion of results (Cai, 2021; Kölbel et al., 2022). To avoid this, a rather novel approach is necessary that analyses the text holistically using an assorted combination of POS chunks to decrease the probability of overlooking phrases that determine the context. A NLP technique denoted as chunking is customised and assimilated in the algorithm. Chunking essentially identifies sequences of words that belong together in a sentence based on their grammatical role and extracts the contextually important sequences of words as units of meaning. Rather than utilising predefined rules and patterns, the algorithm is adapted to identify

grammatical combinations up to three consecutive words including noun, noun+noun, noun+noun+noun, adjective (adj.), adj.+adj., adj.+adj.+adj., adj.+noun, adj.+noun+noun adj.+adj.+noun. Initial iteration stages of NLP computation showed inadequacy in identifying different cases of alphabets and punctuations (see Annex 1). A computation loop was added to counter and identify same words in different case-sensitivity and avoid duplication of same keyword in output. A more coherent output is obtained in further iterations of the NLP algorithm runtimes after adaptive measures were added. In the final stages of the NLP process, a term-frequency (TF) analysis is carried out on identified keywords. In essence, TF measures the frequency of occurrence of each term in a document or corpus representing the importance of the term in the analysed document. It provides intrinsic value to each keyword that are necessary in an effort to establish correlation or to compare diverse set of documents with varying length and text structure. A well-structured output in spreadsheet format is obtained by using ExcelWriter library of Python for the further manual analysis and validation.

3.1.3 Manual Iteration of NLP output

A manual interpretation of results obtained from NLP analysis is vital for a tenacious approach towards the establishment of topical synergies and correlations. A prominent discrepancy in frequent term analysis was discovered as the NLP engine lacked capacity to incorporate abbreviated words in the account. Notably the NLTK library requires extensive modifications before being able to consider and account for abbreviated wordings in documents. Thus, a rather simplified manual approach was chosen to avoid discrepancies in existing output from NLP analysis. Furthermore, an additional manual iteration was undertaken to indicate the relevance of each keyword within respective text of document. To define the relevance and assign a comparable scale with respect to other data extracted from document, a rather rudimentary version of TF-IDF (term frequency-inverse document frequency) approach was taken which involves proportionating the frequency of term in reference to total word count of corresponding document. The remaining manual iterations involved the sorting of data for the purpose of visualisation and convenience of usage.

3.2 Focus Topics

The clarification of focus topics is an essential part of the SURE funding priority, as they serve as a foundation for subsequent knowledge exchange and

dissemination, as well as for the exchange of case studies and approaches across projects. By way of non-algorithmic analysis, the SURE FSR team had established six such focus topics, as being woven into each project´s efforts of developing locally adaptable solutions and strategies (see section 2.1). In that 'non-technical ' attempt, a rather tenacious Grounded Theory-approach had been taken to identify and classify the most frequent keywords in each project proposal, and to derive an initial project ontology and list of focus topics (BMBF, 2023; FONA, 2023; Slawski et al., 2022; SURE, 2021).

3.3 Results of NLP Analysis

In the process of this NLP analysis, we used all ten project proposals and policies (see Table 1) to identify the most frequent keywords or topic clusters to determine the primary trends and foci of the respective documentation. Additionally, to explore potential links between project proposals and policy framework, a combined text of all proposals was created and analysed with the NLP algorithm to find most frequent terms and notions. Considering the vast number of keywords and their corresponding occurrence in documents, only the top 15 most frequently occurring keywords were retained from the project proposals for scrutiny, to establish consistency and reconcilability for critical analyse of findings. For the policy framework and analyses of all proposal texts, the top ten most frequently occurring keywords were retained.

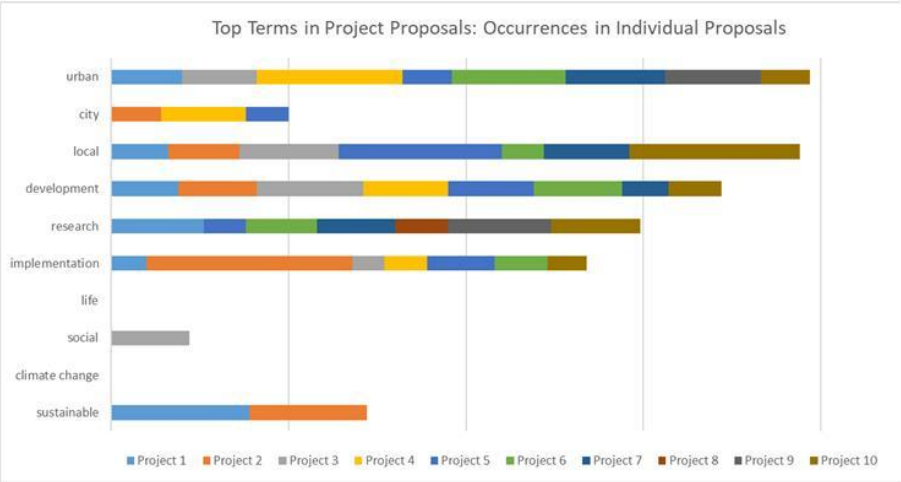

Fig 2: Top terms in Project Proposals: Occurrences in individual proposals

Fig. 2 represents a cross correlation between ten most frequent terms found in the combined text of the ten project proposals and their occurrences in the individual project proposal's 15 most frequent terms. The chart reveals several interesting traits and patterns. Most terms appear frequently in majority of project proposals, while terms 'urban' and 'local' are more prominent than others. Terms 'life' and 'climate change' are surprisingly missing from all ten project proposal's 15 most frequent terms. This could suggest these terms are mentioned as overarching topics and projects tackle them indirectly through their focus topic. Notably there are two outlier terms 'social' and 'sustainable' that appear in only one or two project proposals. Although since text lemmatisation and stemming is intentionally avoided in NLP analysis, other forms of root word sustainable such as sustainability, sustainable, sustainable development are interpreted differently. Thus, it could be that single word occurrence of these outlier terms is accounted differently in other project proposals. This comparison provides valuable insights into key themes and challenges that are undertaken by projects. For example, *project 2* emphasises 'sustainable' and 'implementation' while *project 1* puts more emphasis on 'sustainable', 'research' and 'development'.

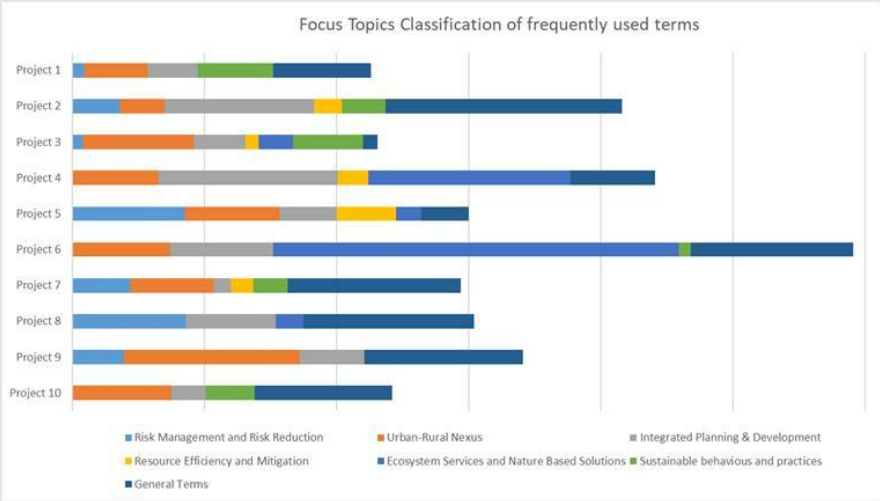

Fig 3: Focus Topics Classification of frequently used terms in project proposals

Fig. 3 illustrates the distribution of focus topic related terms in individual projects keywords. General terms were used to categorise keywords that are difficult to classify within the ontological boundaries of one single focus topic. Findings from Slawski et al., (2022) suggest that focus topics is reflection of BMBF's call for proposal and projects´ thematic focus and skills. NLP analysis

provides a more detailed insight into each projects´ focus. *Project 4* and *project 6*, for example, use 'Ecosystem Services and Nature Based Solutions' related strategies significantly higher than other projects, while all projects utilise 'Urban-Rural Nexus' related strategies in their quest for sustainable urban development solutions. As expected, targeted focus of each project varies greatly thanks to heterogeneous challenges undertaken by each project in combination with diversity in local and cultural environment.

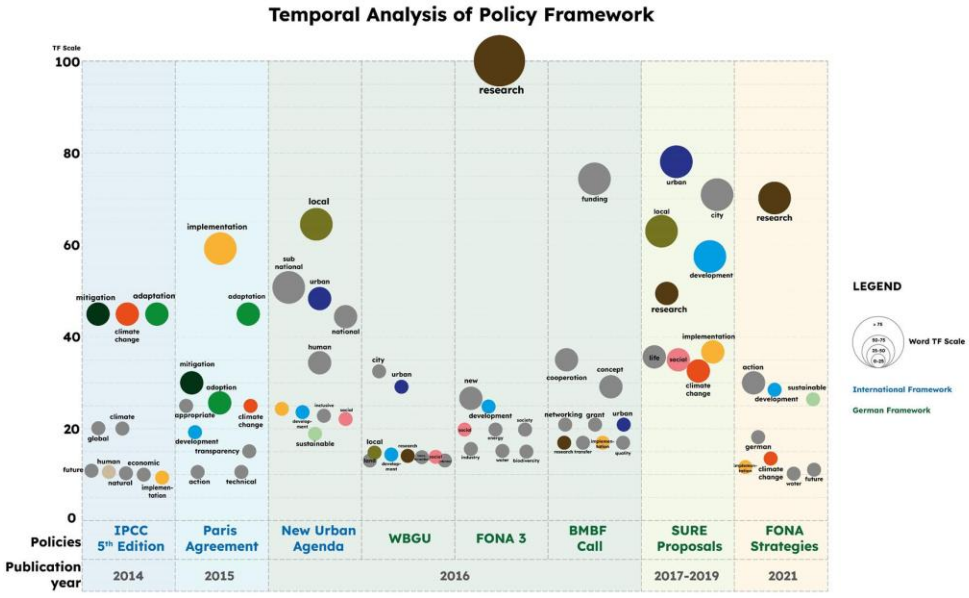

Fig 4: word occurrence over the years (Temporal Analysis)

Fig 4 shows the in-depth interpretation of output from all documents analysed by NLP. Ten Most prominent keywords from each document or webpage are represented according to their relative importance (TF-IDF). This visualization narrates the evolvement of foci of national and international policy framework and in what capacity the existing policy framework has influenced the challenges being tackled within SURE framework. The existing international policy framework has given priority to highlighting and narrating environmental challenges while German policy framework has shown more emphasis on research and development of solutions. The prominent words present in multiple policy documents are highlighted in graph by using bright colour theme while the other words are in grey.

4 Conclusions and Further Discussion

Transdisciplinary research is intrinsically complex, targeting multiple objectives simultaneously. The incorporation of innovative research directives along with traditional research methodology thus benefits the objective of achieving knowledge creation and dissemination across projects in the SURE funding priority. Although sustainable urban development related research puts emphasis on the local environment and context, an overarching and generic framework opens up valuable opportunities for the knowledge synthesis across the individual projects and the funding priority – for the currently running activities as well as for prospective future research. The explorative content comparison conducted via NLP techniques presented in this paper contributes to such objective. The linguistic analysis of project proposals highlights the priorities that each project gives to certain focus topics and challenges. An analogical NLP overview of the national and international policies that have led to SURE funding priority in the past, may line out the most prominent challenges overtime – as well as upcoming ones in the future.

The results show the application potential of NLP analytics in research related to urban development and sustainability science. The contextual preservation of identified keywords and chunks of words has been key for carrying out an effective and meaningful analysis of the given text corpora. The NLTK library has exhibited high confidence while performing POS tagging, chunking and context preservation when performing the preliminary text analysis with the relatively small set of given data from the SURE projects. Although the NLP analysis conducted in this paper is rudimentary, it has exhibited promising insights in projects´ primary focus and challenges. The implications of AI in sustainable urban development research are significant, and our study underscores the need to continue exploring and evaluating the possibilities and limitations of such an approach. An NLP analysis of rich database containing more publications, research articles and other tangible outputs from projects could provide valuable insights and serve as testing platform for various hypotheses. SURE FSR aims to exploit the opportunity to explore various NLP applications including topic modelling and entity recognition. It would support the overall meta-study to consolidate existing knowledge from literature and collaborative projects. Furthermore, NLP model could be trained with enough manual data-tagging to

identify specific challenges in field of sustainable urban development potentially providing insights into most recent challenges and prediction of future trends.

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ANNEX 1

Custom Punctuations list

‘. ‘, ‘, ‘, ‘/ ‘, ‘! ‘, ‘? ‘, ‘; ‘, ‘: ‘, ‘(‘, ‘) ‘, ‘[‘, ‘] ‘, ‘- ‘, ‘_ ‘, ‘% ‘, ‘et ‘, ‘al ‘, ‘et al ‘, ‘a ‘, ‘b ‘, ‘c ‘, ‘d ‘, ‘e ‘, ‘f ‘, ‘g ‘, ‘h ‘, ‘i ‘, ‘j ‘, ‘k ‘, ‘l ‘, ‘m ‘, ‘n ‘, ‘o ‘, ‘p ‘, ‘q ‘, ‘r ‘, ‘s ‘, ‘t ‘, ‘u ‘, ‘v ‘, ‘w ‘, ‘x ‘, ‘y ‘, ‘z ‘, ‘ ‘ ‘, ‘ ‘, ‘ ‘ ‘, ‘ ‘ ‘, ‘ ‘ ‘, ‘ ‘ ‘, ‘- ‘, ‘WP ‘, ‘wp ‘, ‘Wp ‘, ‘| ‘, ‘• ‘, ‘.nr ‘, ‘„ ‘, ‘ ‘ ‘, ‘ ‘, ‘ws ‘, ‘e.g ‘, ‘eg ‘, ‘e g ‘, ‘▪ ‘, ‘… ‘, ‘§ ‘, ‘à ‘, ‘± ‘, ‘ ‘ ‘, ‘°c ‘, ‘ns ‘, ‘hoc ‘, ‘aalml ‘, ‘aatse ‘, ‘– ‘, ‘·’ ‘, ‘. ‘, ‘ ‘ ‘, ‘→ ‘, ‘· ‘, ‘- ‘, ‘i.e ‘, ‘% ‘, ‘ ‘ ‘, ‘ ‘ ‘, ‘[‘, ‘] ‘, ‘{ ‘, ‘} ‘, ‘• ‘, ‘© ‘, ‘< ‘, ‘> ‘, ‘€ ‘

Additional Custom Stopwords

accordance, account, appropriate, available, change, commit, conference, consideration, contribution, country, decision, determined, different, due, example, first session, guidance, high, high confidence, high agreement, importance, information, likely, many, medium confidence, medium evidence, meeting, need, new, order, paragraph, period, possible, ppm, process, project, range, rate, relative, relevant, secretariat, support, table, tion, view, work

How do Open Innovation and Sustainability Practices Affect the Success of Startups?

Serena Filippelli*

Department of Engineering and Architecture
University of Parma
Parco Area delle Scienze 181/A, Parma, Italy

Barbara Bigliardi

Department of Engineering and Architecture
University of Parma
Parco Area delle Scienze 181/A, Parma, Italy

Virginia Dolci

Department of Economics, Science and Law
University of the Republic of San Marino
via Consiglio dei Sessanta, 99 – Dogana, San Marino

Benedetta Pini

Department of Engineering and Architecture
University of Parma
Parco Area delle Scienze 181/A, Parma, Italy

Leonardo Tagliente

Department of Economics, Science and Law
University of the Republic of San Marino
via Consiglio dei Sessanta, 99 – Dogana, San Marino

** Corresponding author*

Abstract

Based on a multiple case study research, the paper aims at providing some first evidence on the adoption of Open innovation and sustainability practices by innovative startups. The focus is on the underlying motivations and the potential effect on startup success of the combined adoption of both types of practices. Following a literature review, an in-depth qualitative analysis has been performed based on five innovative startups based in the Romagna area (Italy) and in the Republic of San Marino. Results highlight that motivations

to Open Innovation adoption are classified in necessity-driven and opportunity driven, differentiating among the lifecycle phases. As for sustainability practices, two main attitudes are recognized in startups: reactive and proactive. Finally, no results on the interrelation between Open innovation and sustainability practices adoption can be found in the investigating sample, leaving room for further studies.

Keywords – Open Innovation; Sustainability; Collaboration; Startups; Startup success

Paper type – Academic Research Paper

1 Introduction

Following Steve Blank's (2010) definition, a startup is a temporary organization in search of a replicable and scalable business model that can take new ideas to market by transforming them into economically viable businesses. However, their small size entails significant difficulties for their development, translated into the concepts of liability of newness and smallness. The former refers to the risk of failure, which is very high in the initial stages of a venture creation, while the latter refers to the scarcity of resources, skills and capabilities (Hannan and Freeman, 1984). Since resources, both tangible and intangible, are a critical factor for startup success, it is necessary to counteract through the opening of business boundaries. In fact, collaborating with a network of external partners mitigates these liabilities as they can bring lacking resources and complementary know-how to the startup (Dickel et al., 2018). This approach has been defined by Chesbrough in 2003 as Open Innovation (OI) and it quickly gained the attention of researchers and practitioners. OI states that firms, especially startups, can and should leverage external resources, technologies and expertise by forming a network of strategic collaborations to cope with the lack of necessary internal resources (e.g., financial, technological, human, etc.). In support of this, recent literature on OI and entrepreneurship confirmed the effectiveness of an open approach marked by interorganizational collaborations in ensuring the success of a startup (Marullo et al., 2018).

In addition, startups have become increasingly aware of environmental issues in recent years, leading to a growing increase in investments on green economy and sustainability (e.g., de Faria et al., 2021). The origin of this trend can be traced back to the mid-1990s, where a wave of greening of industry in Europe and the industrialized world appeared (Freimann and Waltherm 2001). In the years since,

sustainability, declined in its three dimensions of environmental, social and economic, has become a priority for governments and companies worldwide. However, implementing more sustainable business practices in established companies requires considerable effort, calling for a total overhaul of organizational culture in most cases. In contrast, startups are more inclined to embrace sustainable approaches, often declined in the adoption of the Circular Economy concept to their businesses (Bigliardi and Filippelli, 2021). Based on these premises, it follows that the future of startups is inevitably geared toward sustainable innovation through the adoption of an open approach.

However, although numerous studies highlight the growing academic interest in testing the relevance of adopting OI and sustainability practices in startups, to date there is no scholarly work linking the combined adoption of both these practices to startup success.

For this reason, the present article aims to identify sustainability practices, with a specific focus on environmental and social ones, and OI practices adopted by startups in order to understand how they contributed to its success. This objective has been declined into specific research questions.

RQ1. What are the motivations for a startup to resort to sustainability and OI practices?

RQ2. What are the characteristics of startups that adopt both sustainability and OI practices?

Given the nature of the research questions identified and the phenomenon investigated, the study has been conducted using case study methodology (Yin, 2014). The use of qualitative research provides a better understanding of the dynamics of startups in adopting OI and sustainability practices. The study was conducted as part of the RESPONSE research project, sponsored by the University of the Republic of San Marino, therefore the sample analyzed is composed of innovative startups located in the area of San Marino and Romagna (Italy).The remainder of the paper is organized as follows: in section 2 the adopted methodology is presented, in section 3 review results are displayed while section 4 and 5 are devoted to multiple case study results and final discussion, respectively.

2 Methodology

2.1 Research design

A two-step methodology was used to answer the identified RQs: the first consisted of a literature review, while the second of multiple case studies. The literature review enabled the theoretical foundations of the topic under study to be traced (Green et al., 2006; Kafetzopoulos, 2022) and was a key starting point for answering the first research question regarding the motivations for a startup to employ OI and sustainability practices. For this purpose, a narrative literature review was conducted on the Scopus and Web of Science databases. Then, due to the qualitative nature of the research questions identified and the phenomenon investigated, the second part of the study leverages on the multiple case study methodology (Yin, 2003). The use of multiple case studies allows for the construction of a more robust and generalizable theory than a single case (Eisenhardt and Graebner, 1989). The selected unit of analysis was the individual innovative startup (or high-tech startup, as per the San Marino statute), based in the Romagna area (central-northern Italy) or the Republic of San Marino. A startup is defined as innovative if it meets at least one of the following requirements: (1) it incurs expenses in R&D and innovation equal to at least 15 percent of the greater value between turnover and cost of production; (2) it employs highly qualified personnel (at least 1/3 PhDs, doctoral students or researchers, or at least 2/3 with a master's degree); (3) it is the owner, depositary or licensee of at least one patent or the owner of registered software. Since the study is part of the RESPONSE Research Project sponsored by the University of the Republic of San Marino, the startups were selected from those incubated by San Marino Innovation, CesenaLab and Romagna Tech. This selection led to the identification of 5 cases. Data collection was carried out through semi-structured interviews supported by a research protocol consisting of both open and closed questions.

2.2 Case selection

The innovative startups were selected from a sample of 50 startups involved in the larger RESPONSE research project. As Eisenhardt (1989) suggests in case study research it is preferable to select cases by applying specific criteria rather

than selecting a random number of units from a larger sample. Since the present study aims to generalize the results to understand the dynamics of innovative startups with respect to OI and sustainability practices, the cases were selected using the following criteria: startups (1) are at different stages of the lifecycle; (2) operate in different economic sectors; and (3) have different sizes (measured in terms of numbers of employees). The resulting 5 cases are presented in Table 1.

Table 1. The investigated sample of innovative startups.

Case startup[1]	Industry	# employees	Stage of startup lifecycle
A	Pharmaceutical	11-20	Market Launch
B	Healthcare	0-5	Product Development
C	Finance	>30	Growth and Expansion
D	Services	0-5	Market Launch
E	Services	0-5	Growth and Expansion

2.3 Data collection and analysis

The researchers collected data about the types of implemented OI and sustainability practices and motivations (RQ1) through semi-structured interviews that took place through the Teams platform or by telephone. Respondents were preliminarily provided with the list of questions so that they could adequately prepare for the interview, collecting hard-to-obtain information if necessary. To enable triangulation of data (Yin, 2014), this information was compared and supplemented with analysis of official documents such as company websites.

Empirical data from the semi-structured interviews were analyzed using an inductive approach in which a list of OI practices, sustainability practices, and motivations was first identified for each innovative startup. The responses of the individual startups were compared and discussed among the researchers who conducted the study, thus applying researcher triangulation (Yin, 2014).

[1] *For privacy issues, names of startups could not be shown.*

3 Literature review

3.1 Startups and OI practices

Although the literature on OI is growing rapidly, studies focusing on startups are still limited. In fact, several authors (e.g., Bigliardi and Galati, 2018) have focused on SMEs, which share with startups the liabilities of smallness and newness. However, startups are unique entities that face a unique set of challenges, as they do not yet have established business processes, a solid customer base and reputation. This entails a difficulty in attracting investment, talents and consumers, resulting in tough commercialization of products or services.

The literature highlights the suitability of the OI approach to overcome liabilities of newness and smallness (Kraus et al., 2020). In fact, OI refers to a strategy in which companies actively seek resources from a variety of external sources, such as universities, research centers, suppliers, customers, other companies to improve their internal innovation capability (Chesbrough, 2003). Scientific research has identified two main modes of OI: inbound and outbound. Inbound OI refers to an organization actively seeking external resources, technologies or ideas to support the internal innovation process, while outbound OI occurs when an organization makes internally developed ideas and technologies available to external partners for further development and commercialization (Cassiman and Valentini, 2016). Both modes can bring significant benefits to startups, however they come with their own set of challenges and risks. Inbound OI allows startups to complement the owned resources with external ones, which are essential for fostering innovation, but at the same time it reduces control over internal expertise and weakens their knowledge appropriability (Cassiman and Veugelers, 2006).) On the other hand, outbound OI allows startups to leverage their ideas and technologies to generate additional revenues and create partnerships with external companies, however, this implies shared control over intellectual property and proprietary information (Von Hippel and Von Krogh, 2006). To mitigate these risks, startups must provide strong intellectual property protection mechanisms (Halt et al., 2017). There is also a third mode, called coupled OI, which involves the coupling of knowledge inflows and outflows and describes how parties collaborate on innovation, (e.g.,

through the establishment of long-term relationships, alliances, networks or consortia, etc.) (Hasche et al., 2017)

Since this approach requires additional effort to align the different actors involved, it is less likely to be undertaken by a company still in its infancy (Almeida, 2021). Many studies on OI adoption focus on the broad dimensions mentioned above, i.e., inbound, outbound, and coupled, while others go into more detail about the individual approach and consider one or more individual OI practices (e.g., Liu et al., 2020). Since the startup is an unstructured organization, often lacking a clear organizational structure and well-defined processes, it is more effective to consider the OI paradigm at the level of the individual practice to be implemented. This paper uses the definition proposed by Lu and Chesbrough (2022, p.1) who define OI practice as "the actual application or use of the ideas or methods based upon OI that companies implement for their innovation-related processes." Table 2 presents the main OI practices discussed in the literature. It shows that none of them is specific to startups, although they can be indiscriminately exploited by them as well. In addition, few studies contextualize the adoption of one or more OI practices in startups (e.g. Battistella et al., 2017) suggesting the need to expand knowledge with further studies.

Table 2. OI practices.

OI practice	Description	Reference
Competitions/awards	Participation to innovation challenges	Battistella et al. (2017); Chesbrough and Brunswicker (2014); Santoro et al. (2019)
Networking	Networking with different organizations without a formal contractual relationship, such as at conferences, to access external knowledge	Chesbrough and Brunswicker (2014); Santoro et al. (2019)
University research grants	Funding for research projects/fellowships/grants at universities to access outside knowledge	Battistella et al. (2017); Chesbrough and Brunswicker (2014)
Publicly funded R&D consortia/R&D collaboration and technology alliances/consortia	Cooperation between non-competing firms to pursue a common innovative goal (without shareholding)	Battistella et al. (2017); Chesbrough and Brunswicker (2014); Santoro et al. (2019)
Contracting with external R&D service providers	Contracts with external service providers for dedicated R&D projects	Battistella et al. (2017); Chesbrough and Brunswicker (2014); Santoro et al. (2019)
Dyadic co-creation/ co-development in the upstream	Involvement of suppliers in the innovation process	Battistella et al. (2017); Chesbrough and Brunswicker (2014); van de

network		Vrande et al. (2009)
Collection of information from external sources	Range of informal activities aimed at acquiring and maintaining connections with external sources of knowledge	Battistella et al. (2017); Chesbrough and Brunswicker (2014); Oliveira and Alves (2014); Santoro et al. (2019); van de Vrande et al. (2009)
Dyadic co-creation/ co-development in the downstream network	Involvement of customers/end users in the innovation process	Battistella et al. (2017); Chesbrough and Brunswicker (2014); Santoro et al. (2019); West and Bogers (2014)
Crowdsourcing	Outsourcing an innovation task to an undefined crowd in the form of an open call	Almirall et al. (2014); Battistella et al. (2017); Chesbrough and Brunswicker (2014); Santoro et al. (2019)
Specialized services from OI intermediaries	Intermediary organizations that link companies needing OI support to a network of potential solvers	Chesbrough and Brunswicker (2013); Chesbrough and Brunswicker (2014)
IP in-licensing	Licensing of external intellectual property rights via formal licensing agreements	Chesbrough and Brunswicker (2014)
Horizontal technology collaboration	Competing or non-competing companies which join forces to pursue a common goal	Santoro et al. (2019)
Joint venture	Strategic and financial investments in independent joint ventures together with external partners	Chesbrough and Brunswicker (2013); Chesbrough and Brunswicker (2014)
Corporate business incubation and venturing	Business incubators or accelerators that help to develop potentially successful ideas and provide supportive environments for entrepreneurs	Chesbrough and Brunswicker (2014)
IP out-licensing and patent selling	Licensing of internal IP to external organizations via licensing agreements or selling via single payment	Chesbrough and Brunswicker (2014)
Donations to commons or nonprofits	Donations to commons or nonprofits (e.g., open-source communities) to support external R&D	Chesbrough and Brunswicker (2014)
Spinoffs/ Academic spinoffs	Investment in new ventures founded by company employees outside the boundaries of the organization or by academics willing to commercially exploit research results	Chesbrough and Brunswicker (2014)

3.1.1 Startups motivations

Startups benefit from such practices in ways similar to established companies, however, their motivations for using them are different and vary depending on the stage of the lifecycle the startup is in. The lifecycle of a startup can be summarized by the following broad phases: idea generation, development, market launch, scale and exit (i.e. growth and expansion), each characterized by

specific needs (Marcon and Ribeiro, 2021; Picken, 2017). The idea generation phase involves the generation of ideas and their subsequent evaluation to determine which possesses the greatest potential to become a viable business. The development phase corresponds to the realization of the service product, while in the market launch phase the startup focuses on expanding the customer base, building its brand, and optimizing operations to achieve sustained growth. Subsequent phases are concerned with the growth and expansion of the startup.

The motivations for startups to use OI practices can be grouped into two broad categories: necessity-driven and opportunity-driven (Table 3). The former stem from the startup's need to address specific challenges or find solutions to limitations to their operations. They relate to the lack of fundamental resources, in-house expertise or technologies that does not allow it to move its project forward and out of the initial idea generation phase. The second ones, on the other hand, stem from the intention to find new and innovative solutions, create new business opportunities, and leverage external resources and expertise to push its internal innovative capabilities. These motivations mostly arise in the market launch, growth and expansion phases, where the startup already possesses the essential resources for survival but needs the benefits of OI to scale.

Table 3. Startups motivations to adopt OI practices crossed with startup lifecycle stage

		Idea Generation	**Product Development**	**Market Launch**	**Growth and Expansion**	
						Reference
Necessity-driven motivations	Lack of knowledge (market, scientific and media knowledge) and expertise	X	X	X	X	Bigliardi and Galati (2018); Marullo et al. (2018); Spender et al. (2017); Usman and Vanhaverbeke, (2016); Van de Vrande et al. (2009)
	Lack of capacity				X	Van de Vrande et al. (2009)
	Lack of financial resources		X	X	X	Bigliardi and Galati (2018); Marullo et al. (2018); Spender et al. (2017); Usman and Vanhaverbeke, (2016); Welbourne and Pardo-del-Val (2009)
	Lack of human resources	X	X	X	X	Bigliardi and Galati (2018); Marullo et al. (2018); Spender et al. (2017); Usman and Vanhaverbeke, (2017);

						Van de Vrande et al. (2009); Welbourne and Pardo-del-Val (2009)
Opportunity-driven motivations	Speed to market				X	Chesbrough and Schwartz (2007); Van de Vrande et al. (2009)
	Cost savings			X	X	Chesbrough and Schwartz (2007); Van de Vrande et al. (2009)
	Risk sharing				X	Chesbrough and Schwartz (2007); Kutvonen (2011); Usman and Vanhaverbeke, (2016); Van de Vrande et al. (2009); Welbourne and Pardo-del-Val (2009)
	Gain market power				X	Chesbrough and Schwartz (2007); Kutvonen (2011); Usman and Vanhaverbeke, (2017); Welbourne and Pardo-del-Val (2009)
	Better alignment with industry trends	X			X	Van de Vrande et al. (2009)
	Improved customer insights	X		X	X	Marcon and Ribeiro (2021)
	Improved innovation culture				X	Welbourne and Pardo-del-Val (2009)
	Better access to talent				X	Elia et al. (2020)
	Increased brand visibility				X	Chesbrough and Tucci (2020)
	Facilitate international expansion				X	Welbourne and Pardo-del-Val (2009)
	Increase reputation				X	Usman and Vanhaverbeke, (2017)
	Improve innovation process		X	X	X	Van de Vrande et al. (2009)

3.1 Startups and sustainability practices

Major social and environmental challenges are requiring companies to change current business models, adapting them to new needs that necessitate the generation of not only economic but also social and environmental value. In response to these needs and the pressures posed by the achievement of sustainable development goals, entrepreneurship has gained new challenges to face. As a result, there has been a growing interest from the scientific community in the topic of sustainability and sustainable development. Following the study by

Bansal et al. (2019), the concept of sustainability is often used to describe the ability to strike a long-term balance between economic growth, social progress and environmental protection. This definition is rooted in the "triple bottom line" approach introduced by Elkington and Rowlands (1999), according to which sustainability is developed on three distinct but intertwined levels: social, environmental and economic dimensions. At the corporate level, sustainability takes on the characteristics of a value creation process that takes shape through innovation activity (Weissbrod and Bocken, 2017). Specifically, the creation of sustainable value, that contemplates social economic and environmental values, is implemented through the adoption of sustainability practices (Sardana et al., 2020). Companies that adopt them aim to minimize negative impacts on people and the environment while maximizing economic effectiveness. This includes the need for responsible management of natural resources, use of low-impact technologies, protection of workers' and consumers' rights, business ethics and transparency (Epstein and Buhovac, 2014). Sustainability practices take many forms, depending on the industry and the company's specific situation. For instance, a manufacturing company may reduce its environmental impact by adopting low-carbon technologies, using recyclable materials, or improving energy efficiency (Bjørnbet et al., 2021). A service company can commit to providing services that respect workers' rights and promote diversity and inclusion (Govindan et al., 2021).

Table 4 shows the main sustainability practices, respectively environmental, social, and economic, implemented at the company level.

Table 4. Sustainability practices

Sustainability practice	**Sustainability dimension**	**Reference**
Reduced material use per unit of output	Environmental	Milana and Ulrich (2022)
Reduced energy use per unit of output	Environmental	Milana and Ulrich (2022); Schick et al. (2002)
Reduced CO2 'footprint' (total CO2 production) by your company	Environmental	Milana and Ulrich (2022)
Use of renable sources of energy	Environmental	Milana and Ulrich (2022)
Use of 'closed loops' to re-use material waste for the generation of energy	Environmental	Schick et al. (2002)
Development of environmentally friendly products (i.e. recyclable products or products made from materials with low environmental impact)	Environmental	Schick et al. (2002)
Replaced materials with less polluting or	Environmental	Milana and Ulrich (2022)

hazardous substitutes		
Assessment of suppliers' environmental performance	Environmental	Khaksar et al. (2016)
Reduced soil, water, noise, or air pollution	Environmental	Milana and Ulrich (2022); Schick et al. (2002)
Recycled waste, water, or materials/waste sorting	Environmental	Milana and Ulrich (2022); Schick et al. (2002)
Used recycled input materials to manufacture primary products/services	Environmental	Milana and Ulrich (2022)
Compliance with environmental regulations	Environmental	Schick et al. (2002)
The offering of discounts for environmental and social groups	Environmental	Schick et al. (2002)
Increased health and safety aspects for your employees at the workplace	Social	Milana and Ulrich (2022)
Introduced product or service categories with improved health or safety impacts	Social	Milana and Ulrich (2022)
Provided additional training and/or assistance to upgrade employee skills	Social	Milana and Ulrich (2022)
New employee hires during the reporting period	Social	Milana and Ulrich (2022)
Implementation of fair labor policies, such as fair working conditions and fair wages for all employees	Social	Milana and Ulrich (2022)
Provide complain opportunities for customers or employees through formal grievance mechanisms	Social	Milana and Ulrich (2022)
Support for local and global sustainable development projects	Social	Patel et al. (2017)
Creation of jobs and training opportunities for local communities	Social	Scavarda et al. (2019)
Generated new sales	Social	Milana and Ulrich (2022)
Generated profit	Social	Milana and Ulrich (2022)
Opened new market and product/process opportunities for the firm	Social	Milana and Ulrich (2022)
Enhanced economic development in areas of high poverty	Social	Milana and Ulrich (2022)
Received financial assistance from a public authority	Social	Milana and Ulrich (2022)

However, implementing more sustainable business measures can be an arduous and lengthy process, especially if the company must change its existing organizational culture. In fact, because the adoption of sustainable practices should not be viewed merely as an addition to daily operating procedures, but as an integral part of the company's business model, they need to be integrated into the company's strategy and supported at the senior management level (Freimann and Walther, 2001). For these reasons, implementing such practices in startups

that are less structured companies where there is not already a rigid organizational culture may be a more promising approach. In new ventures, sustainability can be integrated from the idea generation stage, rather than being considered as an option to be added later. In addition, founders of startups are often more open to new ideas and innovations, providing greater flexibility and less organizational inertia (Terán-Yépez et al., 2020).

4 Multiple case study results

To present the results, the 4W model of OI proposed by Bigliardi and Galati (2018) has been adopted. It frames the OI process of SMEs, focusing on the object of OI (What dimension), the actors involved (With Whom dimension), the motivation (Why dimension) and the mode (How dimension). Since the present study analyzes startups, the When dimension was added to identify the lifecycle stage in which the startup resorted to OI.

Regarding the adoption of sustainability practices, in the present study we analyze the results by adapting the framework of Wu et al. (2018) and considering two main levels of corporate sustainability. The first level is determined by the current regulatory system, which acts along three main lines: it (1) prohibits behaviors that are harmful to the environment or people; (2) conditions certain production activities to comply with a given degree of environmental impact or social riskiness; and (3) incentivizes sustainable behaviors. The second level consists of strategies, investments, and activities that the company carries out to increase the social and environmental value, in an integrated way with the economic value, of its business.

4.1 Open Innovation

Startup A resorted to inbound OI practices by collaborating with universities, research centers and industry professionals (i.e., doctors). The collaboration with university and research center served in the experimental phase (i.e.idea generation and product development). Specifically, the startup A funded a fellowship at a university in central Italy to conduct specific research useful for ideating the product. The collaboration with professionals in the field was realized in the idea generation phase through a brainstorming activity aimed at circumscribing the specific need and in the market launch phase to later modify the product. The motivation for the startup A to resort to these forms of

collaborations is related to the lack of scientific expertise and the need to enter the market quickly.

Startup B resorted to external collaborations in the idea generation and product development phases to address the lack of specific knowledge regarding the medical industry. Since the startup provides tools to support medical personnel in managing patients with specific diseases, the founders felt the need to complement their expertise with specific medical knowledge. The startup B entered collaborative relationships with its suppliers, from whom it drew qualified human resources. In addition, discussions with users (i.e., patients) through brainstorming activities enabled the creation of a product as close as possible to their needs.

Startup C is the only one in the sample to use outbound OI: it patented three products under a single brand name that are made available to third parties to create innovative products in turn.

Startup D creates an innovative digital product that facilitates accounting management for Amazon resellers. The founders drew on the expertise of established enterprises and users. The former operates in the training business, providing the startup D with specific knowledge about how e-commerce works. The latter consists of users, represented by companies selling through the Amazon channel (B2B customers) who express specific needs considered by startup D must in product ideation and development. For these reasons, the startup D has resorted to collaborations with external parties in the stages prior to bringing the product to market, while soliciting feedback from users to improve the product already on the market in the growth and expansion stage.

The core business of startup E concerns making client companies' processes more effective through algorithms and artificial intelligence. The object of OI is intangible resources, such as missing technological knowledge and skills. To acquire it, the company work together with competing companies, research centers (CNR) and university. Specifically, it collaborated with the University of Bologna on the creation of a digital solution, later patented, to serve a client company. Competing companies and the research center, on the other hand, participated with the startup in a joint project to provide digital expertise to third-party clients. The aforementioned collaborations, which contributed positively to the process of inbound OI, took place mainly in the market launch and growth and expansion phase, enabling the company to expand its customer base and

consolidate its market position. An overview of the five cases is provided in Figure 1.

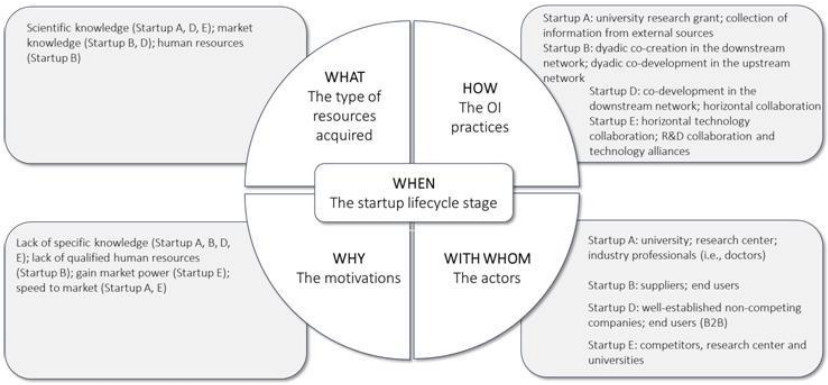

Figure 1. Sample cases represented through the modified 4Ws model.

4.2 Sustainability

Startup A considers sustainability as a pillar of the company's vision and mission. The startup operates in the pharmaceutical sector and has manufacturing facilities. Regarding environmental sustainability, it currently adheres only to norms and regulations, but plans to implement strategies to lower the environmental impact of production as soon as it has more economic resources. In contrast, the startup shows a proactive approach to social sustainability as it has outsourced packaging production to a social cooperative based in the area while incurring a higher cost than in-house production.

Startup B does not have an avowedly sustainable purpose, nor does it have a sustainable or circular business model, yet sustainability is covered in the company's vision and mission. In fact, the innovative product offered has a positive impact on environmental and social sustainability. Regarding environmental sustainability, the product allows the patient to enjoy the necessary care at home instead of traveling to a facility, decreasing the emissions produced to get there. In addition, when evaluating suppliers, the startup's choice falls on the greenest ones. Regarding social sustainability, startup B displays a strong commitment to its community because the service it offers contributes positively to the well-being of its citizens. In addition, the startup plans to do corporate philanthropy by donating part of the proceeds to nonprofits organizations in the field of healthcare. This has not yet been possible because

the startup is still in the product development stage, so it does not have sufficient financial capacity.

Startup C contributes positively to social and environmental sustainability although the company's vision and mission were not designed with this goal in mind. In fact, the startup has created an innovative product for the middle east market (from Morocco to Vietnam), considered a developing area. The product allows the local population to benefit from banking services despite not having a bank account, thus it contributes positively to the social development of these areas. In addition, the product allows for a decrease in the consumption of physical resources (e.g., paper) as it ensures the digitization of banking services. It can be concluded that sustainability, both social and environmental, was an indirect consequence of the startup's core business.

Startup D approaches sustainability, both environmental and social, by simply fulfilling regulatory obligations. Specifically, by operating with Amazon the startup must be compliant with additional requirements imposed by the latter. Amazon, through its auditing activities, verifies the startup's ongoing adherence to them.

Startup E has a strategic approach to corporate sustainability incorporating the values of social and environmental sustainability into its vision and mission. Since its core business is an intangible product, the startup does not have a circular or sustainable business model, however, it actively strives for sustainability principles to underpin its business operations. From the perspective of environmental sustainability, startup E has a strict supplier selection process that is based on the level of environmental impact generated. Specifically, startup E only uses cloud service providers that claim to use renewable energy. Regarding social sustainability, the company is strongly committed to work-life balance by allowing its employees to benefit from agile working. An overview of the startups' sustainability practices is provided in Figure 2.

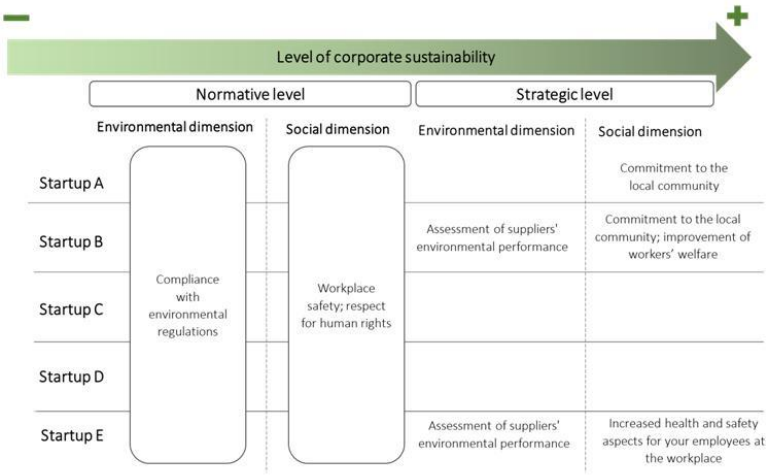

Figure 2. Startups sustainability orientations.

5 Discussion and conclusion

To answer the RQs, he results of the literature review were compared and integrated with that of the multiple case study. Regarding the motivations driving startups to use OI practices, two categories were recognized: necessity-driven motivations, found more in the idea generation and product development phases; and opportunity-driven motivations, more related to the market launch and growth and expansion phases. The sample startups exhibited necessity-driven motivations to a greater extent, and opportunity-driven motivations to a lesser one. As shown in Figure 3, the empirical evidence showed that in the preliminary stages of idea generation and product development, startups resorted to OI practices to complement the resources already possessed, in line with the findings of the literature review (Kraus et al., 2020). Specifically, out of five startups, only one realizes a physical product (Startup A), while the remaining have developed a digital innovative product (i.e. web application or software). Regardless of the type of product made, in the idea generation and product development stages the main motivation is access to missing resources. Specifically, these resources are mostly intangible, including scientific knowledge (i.e., technological and R&D knowledge) and market knowledge (i.e., information about the industry and the needs to be met) (Bigliardi and Galati 2018). In one case, the startup needed skilled human resources at the product development stage (startup B). In contrast, in the market launch and growth and expansion

phases, the motivations shift toward opportunity-driven ones, in accordance with what is inferred from literature. In fact, in these phases, the product is already on the market and the collaborations mostly serve to enable the organic growth of the startup, both in terms of size and market share. In the investigated cases, the main motivations are classified as rapid market access (market launch phase, startups A and E), increased market power, and improved product development processes (growth and expansion, startups D and E). Only startup E manifested necessity-driven motivation at a stage later than product development, due to a lack of sufficient technological expertise to modify the product once it was brought to market.

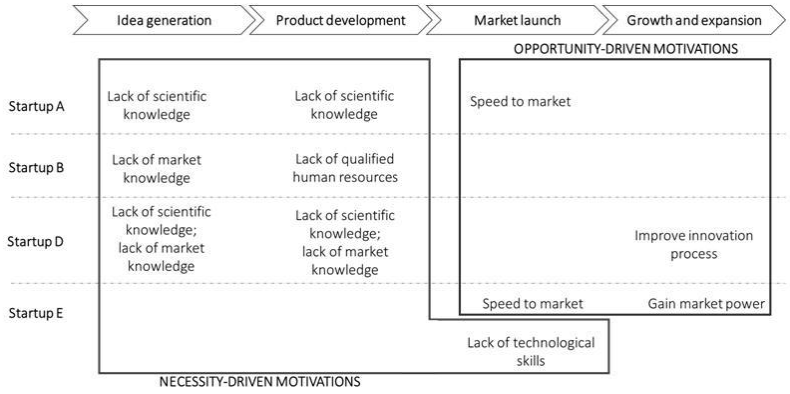

Figure 3. Startups OI motivations with respect to lifecycle stage: the why and when dimensions (Startup C is not displayed as it dit not resort to inbound OI practices).

Regarding sustainability practices, two levels of corporate sustainability are recognized in the literature from which the startup's motivations for adopting them are derived. The two levels are summarized as: reactive attitude, in which the startup applies sustainability practices out of adherence to rules and regulations; and proactive attitude, when the startup invests in strategies to promote corporate sustainability, which is inherent in its vision and mission. Of the startups investigated, three take a proactive attitude (i.e. startups A, B and E) while the remaining manifest a reactive attitude.

In light of these results, however, a further distinction needs to be made. In fact, although some startups have not resorted to sustainability practices to comply with corporate vision and mission, they have nonetheless contributed positively to environmental or social sustainability. For this reason, a distinction

should be made between intentional sustainability and accidental sustainability. The former refers to startups having a proactive attitude toward sustainability while the latter refers to startups that, although they have manifested a reactive attitude, have had a positive impact on sustainability. To this second group belongs the startup C which has created an innovative product that, when used by third-party companies, enables them to increase their level of corporate sustainability. Such a startup can be regarded as a vehicle for sustainability.

Regarding the second research question, namely the profile of startups that resort to both OI and sustainability practices, the evidence from multiple case studies did not show an interrelation between them. The startups under study did not need to use OI for the specific purpose of implementing corporate sustainability practices, just as the use of OI practices did not have an intended impact on corporate sustainability. Indeed, in the literature, the link between OI practices and sustainability can be considered from two different perspectives: on the one hand, OI is the means by which the organization can implement sustainability practices; on the other hand, the use of OI is an indirect cause of sustainability. In the first case, an organization may resort to a network of collaborations for the express purpose of increasing corporate sustainability. In the second case, the organization resorts to OI for different reasons (e.g., lack of internal expertise; lack of qualified personnel, etc.), but it can still achieve a positive impact on sustainability: for example, it can select collaborators based on their level of sustainability, or it can help make third parties (e.g., its customers) more sustainable by producing an innovative product thanks to external collaborations. Consistently to previous studies (e.g. Kraus et al., 2020), our paper points out how external collaborations helped founders of innovative startups to make up for lack of relevant resources in both idea generation and product development phases, as well as to boost their growth in the subsequent stages.

Moreover, relevant findings are obtained on the sustainability side, highlighting a tendency of digital-based startups to operate as sustainability-accelerators, or vehicles, for other organizations.

5.2 Limitations and future research avenues

Despite expectations, there is no relationship between sustainability practices and OI practices adopted in the sample investigated. A distinguishing feature of this phenomenon is the core business of the investigated startups, which is

represented by the creation of a digital product, thus intangible (except for startup A). In this regard, future studies may replicate the analysis on a more heterogeneous sample to test whether core business influences the interrelationship between OI practices and sustainability. In fact, our sample consisted of innovative startups, most of which are configured as digital. Broadening the sample to manufacturing startups could reveal different trends. This further analysis could highlight factors enabling or hindering the use of OI practices to support corporate sustainability, and vice versa. Some limitations of this study should be noted. First, the small number of cases analyzed, and the geographical location limited to the area of Romagna (Italy) and the Republic of San Marino do not allow generalization of the results. The same is true for sector specificity effects; in fact, our study is mostly based on innovative startups making web or software applications; further research is needed to explore the phenomenon in other low-tech sectors.

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Managing Knowledge Transfer in a Team: Insights from a Public Sector Project

Paolo Canonico

Università degli Studi di Napoli Federico II
Naples, Italy

Ernesto De Nito*

Università di Salerno
Via Giovanni Paolo II, 132
84084 Fisciano (SA), Italy

Vincenza Esposito

Università del Sannio
Piazza Guerrazzi,
82100 Benevento. Italy

Mario Pezzillo Iacono

Università della Campania Luigi Vanvitelli
Viale Abramo Lincoln n. 5
81100 Caserta, Italy

Marcello Martinez

Università della Campania Luigi Vanvitelli
Viale Abramo Lincoln n. 5
81100 Caserta, Italy

* *Corresponding author*

Abstract

This paper deals with a case of organisational change triggered by a process of digital transformation. It describes the management of change activated in the Supreme Court of Cassation in Italy. The project involved different actors and one of the main criticalities to deal with was the need of communication among people with different background and languages. We analysed how external consultants acted as knowledge brokers to facilitate the knowledge transfer process in a team. The consultants acted in facilitating the

alignment of different languages and lenses using visualising tools and focusing on boundary-spanning activities.

Keywords: Digital Transformation Project, Knowledge brokering.

Paper type – Academic Research Paper

1 Introduction

In the public sector much of the discussion, both in the academic and in the empirical fields, is focused on the opportunity to introduce technology in order to get better services by increasing efficiency and transparency, and improving accountability (Cordella & Bonina, 2012). Critical and urgent problems affected the justice domain where the need of the adoption of ICT is considered a priority in many countries (Agrifoglio et al., 2016).

The main goals for the Courts are to improve services and to be more efficient in the consumption of resources, and to improve transparency and accountability of court activities (Seepma et al., 2021).

This paper discusses a change management process in the Supreme Court of Cassation due to the introduction of online civil trials (Telematics Civil Process). The focus was on the use of electronic tools and communications that enable change from a paper-based to digital flow of information.

In September 2019, the CRUI Foundation (Conference of Rectors of Italian Universities) entrusted the Department of Economics at the University of Campania Luigi Vanvitelli with the implementation of activities within a project on development and organisational change in the services of the Supreme Court of Cassation.

It was to be carried out with the administrative staff of the Supreme Court of Cassation, in collaboration with the Ministry of Justice, especially the Directorate General of Automated In-formation Systems (DGSIA) within the Ministry.

In this digital transformation process, a peculiar role is played by knowledge management, as critical issue in making possible that people making from different perspectives could communicate. During this process, consultants (interpreted as knowledge brokers) can play a key role in facilitating the way people involved in the project interact.

The paper contributes to the literature on knowledge management, and adds to understanding about the role of (and practices developed by) consultants as knowledge brokers in managing a digital transformation team.

2 Managing knowledge in a Public Sector Project

In the public sector, the concept of digital transformation is quite controversial, and it is adopted with regard to different kind of technological initiatives. As many other change projects, a key factor to manage is the capacity of building up new solutions making the different actors interacting.

This issue is a relevant one in the knowledge management literature. For example, Rajalo and Vadi (2017) studied boundary mechanisms adopted to facilitate communication and build a common framework among partners. Collaboration between different actors from diverse organisations often implies knowledge transfer. All the involved actors have their own language, background and expectations of new solutions (Sandberg & Tsoukas, 2015).

To facilitate knowledge transfer, actors need to work together to overcome their individual and organisational interests and needs, and collaborate to achieve a common goal (Canonico et al., 2020). External consultants could play a specific role in making possible people communicate and interact. In this sense, according to our perspective they act as knowledge broker, specialists who enable knowledge transfer across different organisational actors. They mediate between different disciplinary perspectives, facilitating communication, and creating a shared understanding of the problem or issue (Ishiyama, 2016). They act as liaison, gatekeepers, coordinators, representatives, and itinerant brokers. Previous studies have shown that group members can act as knowledge brokers among different groups. We would like to investigate how it is possible to build up a shared language even between people belonging to different organizations.

The aim of our paper was therefore to investigate how knowledge brokers act in a inter-organizational complex project, when the main goal was to find new and common solutions.

3 Methodology

This empirical study was based on a qualitative investigation. We carried out the analysis iteratively using a semi-grounded approach, and our data informed the selection of theories (Van Maanen et al., 2007). We wanted to provide insights

from a unique case that was a valid candidate for theoretical sampling (Yin, 2003). The aim was to support the theoretical analysis of how "academic" knowledge can influence and facilitate knowledge translation and knowledge transfer processes in a project related to digital transformation in an Italian public sector body.

Choosing a single case can be a good way to explore how specific processes and complex issues take place within that case (Yin, 2003). In this study, the case was a digital transformation project triggered by the introduction of the Telematics Civil Process in the Supreme Court of Cassation in Italy.

The case study provided a consistent, differentiated and information-rich setting for studying the relationship between knowledge brokering and knowledge translation. Three data collection techniques were used: documentary analysis, participant observation and semi-structured interviews. First, data were gathered from documentary sources, such as internal reports, the organisation's website, and reports by the Ministry of Justice on the impact of the Telematics Civil Process in the courts of first and second instance. Participant observation was the main source of data for the rest of this study (Canonico et al., 2017). Two of the authors were directly involved in the project team. This insight was used to explore the role of "academic" knowledge broker within the project team. During fieldwork, the two authors spent one day a week at the Court for one year. They had free access to the Court premises, and were able to make both formal and informal contacts and become relatively familiar with the management.

Finally, semi-structured interviews were conducted with the administrative head of the Court of Cassation, two executives from the Ministry of Justice co-involved in the project and three Court clerks. Each interview was conducted by two authors of this paper to reduce interviewer bias (such as first-impression error, nonverbal influences or negative emphasis).

4 Case description

Digital governance of the civil process involves the need to adapt to new forms of language and new practices and activities to replace those traditionally carried out by lawyers, judges, and administrative officers/clerks. The rationale for the introduction of the Telematics Civil Process is to simplify the process requirements for lawyers, magistrates and court clerks. It allows practitioners and offices to exploit the potential of delocalisation and management in

dematerialised form of the various procedural activities, as well as remote consultation of telematic files.

The process has already been tested in Italy in the courts of first and second instance. It is a "systemic" technology, replacing operational practices based on paper-based information exchange, not replaceable and enabling new functions and services. Its systemic characteristic requires strong integration in input–output processes. This implies that there is an ongoing need to verify that upstream and downstream processes meet the needs of those involved, and improve the efficiency and effectiveness of the work of the various professionals involved, both public and private.

The new process was introduced in the courts of first and second instance in 2014. The level of effectiveness and quality of processes and outcomes has been very different across courts, depending on how this technological innovation has been "implemented" and managed, and particularly whether the approach was strictly technological, or also incorporated an organisational perspective.

The experience of the courts of first and second instance has made clear that it is essential that the process of design and implementation of Telematics Civil Process technology systems is not developed using a purely top-down logic. Instead, it needs to be "built" through a collaborative approach of sharing knowledge, practices and experiences of the various stakeholders involved in the process, both internal and external to the courts. The acquisition of "digital" knowledge and skills, for example, cannot be achieved through mere participation in a training course on software features. It requires effective practice, participation and involvement of people in the assessing and redesign of workflows.

The project developed by the University of Campania was based on a scientific approach of "research–intervention". It aimed to develop and implement design solutions and practices that would solve problems within an organisational and social system (Burton et al., 2015). The aim was to achieve the following macro-objectives:

- To assess models and practices of work organisation in the Supreme Court of Cassation linked to the previous technological equipment used by clerks and judges;
- To upgrade the archiving and document management information system in line with the needs and specificities of the Supreme Court of Cassation's stakeholders; and

- To carry out an organisational redesign of the Court's activities and workflows, especially administrative activities and work carried out by the clerks, based on the potential offered by the digital filing of documents related to project implementation.

The project began in September 2019 and ended in early 2021. It was divided into two work packages:

- WP1. Assessing of the status quo (AS IS) (Goodhue & Thompson, 1995) of the Supreme Court of Cassation.
- WP2. Organisational redesign of work practices because of the introduction of the electronic filing and management of documents following both the planning and the implementation of the Telematics Civil Process (TO BE).

The objective of analysis at the first stage (WP1) was to reconstruct, describe and assess the work organisation of the Supreme Court. The start of WP2 coincided with the signing of the memorandum of understanding between the Supreme Court, the Ministry of Justice, the Attorney General's Office, the National Forensic Council and a software house. The framework of the protocol saw this as the start of an experimental phase in the implementation of the Telematics Civil Procedure from October 2020 to upload and test the new information system.

5 Discussion and conclusions

One of the elements that emerged strongly during the kick-off meeting of this design and implementation phase of the projects was related to the critical issues originated by the differences in background and language adopted by the different stakeholders involved in the process.

The researchers therefore proposed to create two separate sub-teams: an operating committee of some clerks, lawyers and technicians from the software house, and a steering committee composed of internal Court personnel. To facilitate communication and organisational coordination, the researchers were part of both sub-teams.

The operating committee had the goal of developing the information system designed by the software house, drawing on the survey provided at the end of the WP1 that upgraded and verified the functionality of the "recommendations". The group provided for the systematic use of meetings and gatherings (including telematics), using a procedure to establish their frequency and content.

The knowledge broker pushed participants to adopt formats and languages that then became common assets of the sharing and collaboration by the use of visualisation tools. Clerks, magistrates and computer technicians have different languages and styles and may fall into the trap of thinking that their knowledge is "correct". This makes it harder to understand another point of view (Sandberg & Tsoukas, 2015). Each person is knowledgeable about specific tools and methods and is often suspicious of other perspectives. In this case, the knowledge broker dynamically built and processed visualisation tools in both the first and second phases of the project. Second, inter-organisational and inter-professional collaboration between project team members created the need for boundary spanning. These were actions and behaviours that aimed to connect separate knowledge, needs and practices by managing interactions and negotiating the meaning and terms of the relationship between project team members. They also facilitated the sharing of knowledge across intra- and inter-organisational contexts (Kislov et al. 2017; Edelenbos et al., 2018).

The paper focused on a case study of organisational change triggered by a digital transformation process, in this case, the introduction of online civil trials in the Supreme Court of Cassation in Italy. The paper highlights the importance of knowledge transfer in a process like this, particularly between different actors and settings, and emphasises the need for mutual understanding and relevance. We showed that external consultants acted as knowledge brokers to facilitate the knowledge transfer process in a team.

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The Role of Social Impact Evaluation in Megaprojects: Reviewing Literature and Analysing Implications from a Managerial Perspective

Paolo Canonico

Università degli Studi di Napoli Federico II
Via Cintia, 21, 80126, Napoli, Italy

Ernesto De Nito

Università degli Studi di Salerno
Via Giovanni Paolo II, 132
84084 Fisciano (SA), Italy

Andrea Caccialanza*

Università Cattolica del Sacro Cuore
Via Emilia Parmense, 84
29122, Piacenza (PC), Italy

Edoardo Favari

Politecnico di Milano – School of Management
Via Lambruschini, 4, Milano
20156, Milano (MI), Italy

** Corresponding author*

Abstract

Megaprojects stimulate and challenge public opinion mobilizing wide citizens' reactions. Given their ability to increasingly attract public attention, they may exert an influence on public participation to collective choices and on political decision making.
These issues are relevant for the evaluation of a project, but unfortunately, they are rarely debated in the managerial literature. Our paper wishes to open up a debate related to social issues and how they could be considered according to a more managerial discussion.

Keywords – Mega-projects; sustainability; social evaluation

Nature of proposed paper - Academic Research Paper

1 Introduction

The diffusion of megaprojects worldwide represents an interesting field both for researchers and practitioners alike. Megaprojects are usually large-scale interventions, such as infrastructures, requiring billions of dollars investments (Brookes & Locatelli, 2015) and long-term perspective to be analysed (Flyvbjerg, 2014). The possibility to meet constraints in terms of budget, time and benefit known as "iron law" (Flyvbjerg B., 2017), in the last decades has been associated with sustainability issues. Research on the sustainability of megaprojects is still not only limited to few geographical areas (such as Eastern China, Western Europe, and Eastern United States), but also suffers the frequent underestimation of the two non-economic pillars, the environmental and the social ones (Wang et al., 2020). Given the emergence of the environmental dimension in the last few decades (Silvius & Tharp, 2013), we are nowadays witnessing the increased awareness for issues of social responsibility. This is "the reason why" we consider the better understanding of the interactions between megaproject and social impact assessment disciplines crucial (Esteves, 2012). In particular, significant effort has been devoted to the understanding of possible causes of megaprojects failures. Megaprojects have often an underestimated effect on local communities and residents that might be affected by a (temporary or permanent) change in terms of their livelihood conditions or life quality (Abdullah & Rahman, 2021). Crisis are more frequently related to project managers responsibility and forecasting ability (Wang et al., 2020) nor, in the cases of the industrialization development focus, with repercussions on the liveability of the local area. Literature has pointed out that there are even cases where an environmental impact analysis has been carried out, the overall project performance has not been effective due to the exclusion of the other social dimension within the perimeter of analysis. Ho et al., (2020) pointed out the disrespect of procedures or increase the dissatisfaction of local participants as possible causes of failure, but this is particularly evident in also the case of "Not In My Back Yard" (NIMBY) infrastructures or facilities with respect to local residents. Marcelino-Sádaba et al. (2015) proposed as research agenda the proposal of "tools that we might call social-design, helping to include social aspects in the project". This issue seems to be still urgent and a current open field for future works, also according to the evolution of the concept of project manager. Current literature aims to encompass this role, extending the analysis of the impacts to the broader concept

of stakeholders and local communities impacted by the project. The aim of this paper is to review the literature related to the interactions between megaproject and social evaluation, trying to reconstruct the existing fragmentation in extant studies. Therefore, for this purpose, previous mapping and systematisation of the social impact of mega-projects was sought. Priorly, Di Maddaloni & Davis (2017), reviewed the influent role of local community in major public infrastructure and construction projects. Moreover, they suggested frequent underestimation of external stakeholders in managerial practices and a focus on primary stakeholders able to control project resources. The applied mixed methodology is the result of the combination of a systematic and inductive approach.

At first we used for the systematic approach the Scopus database to select those works that contains in the title and abstract "Social Impact" AND "Megaproject" as keywords. Secondly, it has been applied an inductive process that aimed to include relevant reference and cross-references present in the papers selected in the first part. This stage was the most conservative and inclusive in terms of preservation of both classical and contemporary project management literature.

We identified different research areas related to the issue of the evaluation of the megaprojects from a social perspective, including the role of power, the importance of the infrastructure and social space, the need of people engagement and endorsement.

Megaprojects, indeed, are related to a logic of growth, development, competitiveness and prosperity, and are shaped as public-private institutional arrangements participated by elites and pro-growth coalitions (del Cerro Santamaria, 2019; p. 263). This is one of the reasons why the long-term social outcomes of urban infrastructure development are rarely assessed (ex-ante) or evaluated (ex post), especially in terms of how the respective interests are or will be affected by the multi-scale spatial changes generated by the projects. Megaprojects stimulate and challenge public opinion mobilizing wide citizens' reactions. Given their ability to increasingly attract public attention, they may exert an influence on public participation to collective choices and on political decision making.

These issues are relevant for the evaluation of a project, but unfortunately, they are rarely debated in the managerial literature, even if the issues of power and equality are coherent with the critical management agenda (see for example

Hodgson and Cimcil, 2006) both from a methodological and theoretical point of view.

Our paper wishes to open up a debate related to social issues and how they could be taken into account according to a more managerial discussion.

2 Methodology

In order to propose a comprehensive overview of the existing literature of the social impact of megaprojects it has been performed a review of the existing contributes.

The applied mixed methodology is the result of the combination of a systematic and inductive approach. This specific filtering strategy allows us to combine "the findings of qualitative and quantitative studies within a single systematic review to address the same overlapping or complementary review questions." (Harden A. 2010) and stimulate the debate within a multidisciplinary topic finding new research gaps. Within the models proposed by literature (Pearson et al., 2015) for a reproducible and comparable selecting process (Stern et al., 2020), it has been chosen and adapted the one proposed by Mok et al. (2015).

At first, we used for the systematic approach the Scopus database to select those works that contains in the title and abstract "Social Impact" AND "Megaproject" as keywords (202). The filtering phase limited the research to the articles, books, books chapters, and reviews published in the English language and at final stage of publication. As a result, 164 documents were found.

Secondly, for those papers it has been done an abstract and full text screening, including 44 papers in the final list considered for the analysis.

Thirdly, the full text screening was aimed at the identification of several elements contained in the codebook for content analysis of the study adapted from the widely used model proposed by Laplume et al. (2008).

Therefore, the quantitative variables analyzed are:

- Year, intended as year of publication;
- Author(s), full author(s)' list;
- Article title, title of the article;
- Journal, publication in which the article was published;
- Methodology, namely: qualitative, quantitative, mixed methods;
- Approach, namely: conceptual, case study, discussion, review;

- Data source, list of sources, namely: survey, interview, secondary data, others (non-excluding also a combination of them).
- Concern, focus: local community, internal stakeholders or both;
- Perspective, depending on the project management, managerial practices, sociology or engineering' perspective adopted (non-excluding also a combination of them);
- Geography, country from which the data was collected;

Moreover, the qualitative variables analyzed are:

- Research question(s), Research question(s) explicitly stated in the article;
- Contribution(s), contribution explicitly stated in the article;
- Finding(s), major finding(s) explicitly stated in the article.

Finally, as output of the inductive categorization step, we defined three research areas with the aim of analyzing and discussing them as homogeneous groups for the managerial perspective adopted:

- Infrastructure and social space, in particular with regard to the different phases (study, construction, maintenance and decommissioning) of large infrastructures that have caused positive and negative impacts on local communities.
- People engagement and endorsement, referred to the methodologies (listening, involvement and endorsement) that have been undertaken to limit the negative impacts of the megaproject, as well as their reactions to the methods of involvement adopted.
- The role of power and social issues, aimed at collecting the contributions that relate the hierarchical relationships of exercise of power by listening to the instances of the categories of stakeholders excluded from the listening perimeter or penalized by the negative externalities of the megaproject.

Within each of these three areas, we filtered also papers not coherent with the mega-project literature and managerial practices. The allocation of each paper was done in parallel by two independent authors, to reduce the influence of subjective perception in the allocation to the category. Instances of different allocations were discussed collectively in order to be able to allocate a single shared allocation.

Finally, due to the proximity of the topics, a sub-group of studies pertaining to the topic of energy transition was identified for the category of infrastructure and

social space alone. Given the importance of the pursuit of a socially equitable ecological transition as well, this peculiarity will be emphasized in the discussion section of the results (Esteves et al., 2012; Sankaran et al., 2022).

In the next section descriptive results are proposed and described in accordance to the categories taken into account.

3 Results

This section aims to represent the distribution of papers within the selected period. In addition, it is intended to offer descriptive insights useful for the next section, which in turn will discuss the themes and contributions of the three inductive categories.

Firstly, it can be emphasised how the interest regarding the study of social impacts in mega-projects has intensified over time and with a peak in 2021 (8 papers).

Secondly, the distribution of contributions in terms of journals is highly differentiated, involving those within project management areas, such as the *International Journal of Project Management* (6) or the *Project Management Journal* (5), as well as management journal or policymaking. Thirdly, it can be observed that their distribution is not uniform either by methodology adopted or by approach (excluding the 5 reviews). With reference to the methodology adopted, Table 1 shows how qualitative approaches (25) prevail by far over quantitative (8) or mixed methods (6) publications. Similarly, in terms of approach, there is a greater prevalence of case studies (34) than of discussion (3) and conceptual papers (2). A first piece of descriptive evidence can therefore be pointed out: the studies that have dealt with the topic of social impact have predominantly taken a qualitative approach geared towards the presentation of a (multiple-)case study (50%).

Table 1 – Distribution of the number of papers by methodology and approach applied.

Methodology / Approach	*Case study*	*Discussion*	*Conceptual*	Total by rows
Mixed methods	4		2	6
Qualitative	22	3		25
Quantitative	8			8
Total by columns	34	3	2	39

Tables 2, on the other hand, analyses the distribution of studies considering data source and concern. In terms of data source, the extensive use of secondary data (16) in the analyses can be emphasised, as well as the combined use of several sources to ensure a better representation of the observed phenomena. In addition, it can be pointed out that there are more and more studies that combine an interest in both internal and external stakeholders; this evidence emphasizes the holistic perspective required for the proper involvement and endorsement of different stakeholder categories (McLeod, 2023).

Table 2 – Distribution of the number of papers by data source and concern.

Data source / Concern	*Both*	*Internal stakeholders*	*Local community*	Total by rows
Interview	5	1	3	9
Interview, secondary data	1			1
Interview, survey		1		1
Survey	2	1	4	7
Survey, secondary data			2	2
Secondary data	7	1	8	16
Others	4	1	3	8
Total by columns	19	5	20	44

Accordingly with the proposed Table 3, we also deepened distribution of the number of papers by deductive group and concern. In particular, it can be noted that much of the analysis of impacts on local communities in mega-projects has been contextualised in infrastructure impact analysis (20), of which 7 referred to the peculiar focus of energy transition.

Table 3 – Distribution of the number of papers by deductive group and concern

Deductive group / Concern	*Both*	*Internal stakeholders*	*Local community*	Total by rows
Infrastructure and social space	8	2	10	20
People engagement and endorsement	8	3	4	15
The role of power and social issues	3	-	6	9
Total by columns	19	5	20	44

Referring to the distribution of the selected analysis perspectives, it is highlighted that frequently the analysis contributed to the project management literature (8), as well as to the conjoint combination of project management and managerial practices in a broader sense (13).

In this section we have presented the distributions of the papers with respect to the most significative categories of analysis. In the next section the detail of each of the three inductive categories will be discussed.

4 Discussion

As mentioned in the methodology our first result was to identify three different research areas related to the issue of the evaluation of the megaprojects from a social perspective: 1) The role of power and social issues; 2) Infrastructure and social space; 3) People engagement and endorsement. In this section we will discuss such areas identifying possible inspirational new trends and research gaps in coherence with a managerial perspective.

4.1The role of power and social issues

Regarding this issue, first of all it is important to underline the journals where papers appeared. There is, in fact, a great variety in terms of scientific research areas, moving from Political science, Economics and Management. From our perspective it is very interesting that even in the managerial community, some scholars (Lee et al. 2017; Badi et al. 2020) are facing social and power issues.

Not surprisingly adopting different lens means sometimes also to change the object of study. For example, Hossain & Fuller (2021; p. 294) looked at mega projects as characterized by political lobbying, privatization and institutional fragmentation which can result in the marginalization of vulnerable communities as well as concerns regarding the transparency and accountability of the decision-making process (In this sense scholars are interested in understanding which are the power relationships among the different actors involved in the mega-project and how they use their forces in order to get their goals. So they want to underline the unequal power distribution among the projects stakeholders.

On one hand, mega-project sponsors have all the interest in presenting the positive relevance of the project itself, giving a partial picture of the situation, underlying the short-term effects (especially the positive economic effects) and undermining the less visible long term social impacts. This uneven power

distribution could imply a strong conflict between different players (in particular the project sponsor organizations, both private and public, and the local community). A clear example of this kind of behaviour is discussed by Hossain and Fuller (2021) who identified four variables that influence this relationship (and this conflict): choice/alternatives, transparency or access to information, integration of local knowledge and power sharing. According to their study, in the official documents there are different choices in order to underline the positive effects of the mega-project, hiding the potential negative social consequences. The language adopted is always positive and offers only one-sided perspective: there is no space for an alternative choice.

Another example in this area is represented by Atkinson (2020), who reflects on hydropower projects, suggesting that the relationship between electricity provision and poverty reduction in rural areas is unclear; further, the benefit of mega-scale energy projects is limited to increases in energy export, with direct benefits being seen primarily by officials and elites.

From a more managerial perspective, it is possible to define very different research issues. At a network level, Rajput et al. (2022) investigates the risk coming from fragile and political regimes, studying how political, social safety and legal risks affect the project performance of a mega-project. Lee et al. (2017) propose a very interesting study reflecting on social conflicts, underlying how external stakeholders, such as NGOs or local residents, have become more critical factors. Looking at the conflict adopting this lens, they find five types of conflict scenarios and suggested different strategies to manage conflicts solutions. Badi et al. (2020) reflect on amore individual level, identifying the role of social power in defining strategic project innovation implemented by the project manager.

This stream of research also include the Politics Effects of Resistance against Mega-Projects (Silva et al., 2018; Wang and Wu, 2019). It is really interesting to reflect on (Silva et al., 2018; p. 28) how social movement actors with various interests and power resources try to influence mega-development projects, trying to denounce how mega projects could negative influence the phenomenon of marginalisation (Wang and Wu, 2019).

Adopting a social power perspective within different research fields reflects the complexity of this issue: in order to define the concept of evaluation in mega-projects in a managerial perspective, we need to enlarge our typical pathways, looking at different disciplines and journals.

4.2 Infrastructure and social space

Another interesting research area could be represented by the effects of mega-projects in urban infrastructure development. According to Lee et al. (2020; p.2) the long-term social outcomes of urban infrastructure development are rarely assessed (ex-ante) or evaluated (ex post), especially in terms of how the respective interests are or will be affected by the multi-scale spatial changes generated by the projects.

For example, Perez-Sindin (2021) reflect on how labour needs change during a mega project development, leading to a situation of potential social and demographic change to local communities. So, he adopted innovative indicators related to crime or social tensions, to evaluate the social impact of the mega-project. Korytárová and Hromádka (2014) proposes to consider different social dimensions to evaluate a mega-project. Evaluating a transport infrastructure project could imply considering changes in the time consumption, changes in operation costs for vehicles, social costs connected with car accidents and newly impacts on environment.

According to Lee et al (2020) and in coherence with other scholars (Geurs and van Wee, 2004; Vecchio, Porreca and Rivera, 2020) the concept of social space is a key construct in order to evaluate the development of urban infrastructure, both at a macro scale (i.e., change in spatial structure of a city) and a micro scale (i.e., change in physical environment in a local area), showing the need for an integrated and broader approach to urban transport infrastructure development that addresses social consequences of multi-scale spatial changes induced by projects, including those that are unexpected or unintended. What is really useful in order to evaluate a transportation megaproject is the Environmental and Social Impact Assessment (ESIA), that according to Mottee et al. (2020) would improve the assessment and management of the social impacts of megaproject.

4.3 People engagement and endorsement

Mega projects are typically criticised for their significant impact on communities and on society as a whole. It is therefore little surprise that they stimulate and challenge public opinion mobilizing wide citizens' reactions. Given their ability to increasingly attract public attention, they may exert an influence on public participation to collective choices and on political decision making.

The diffusion of social media has of course reinforced such phenomenon. Issues about engagement are crucial with reference to the so called Nimby attitude characterizing the negative social response to unwanted facilities that in recent times unfold especially through social media. Social media have brought about new challenges of widescale information diffusion.

According to Wang et al. (2019), focusing on how information related to megaprojects may circulate and develop, it is possible to put forward a series of socio-economic implications of the diffusion of information model. Government administration should understand what kind of social conflict may be prompted by the project. Government should therefore follow a progressive update which should include not only the casualties and economic impacts of the event, but also subsequent framing of the phenomenon, such as results of project evaluation. Important challenges are originated by the interactions between the megaproject and engaged citizens. Wang et al. (2019) argue that government administration should enhance its online influence through micro-blog operations, communicating with elites, defined as the important groups who are extremely active in the communication and directly promote the emergence of peaks of public concerns, to guide the positive online discourse. More generally, with reference to megaprojects, social media may represent a powerful communication channel to deliver public voice integrating public participation in the real world (Tumasjan et al., 2010).

In addition to issues related to social engagement as such, a number of other contributions (e.g. Aaltonen et al. 2008; Aaltonen & Sivonen, 2009; Davis, 2014; Eskerod, and Huemann, 2013) have dealt (broadly speaking) with stakeholder salience, considering people engagement as a potential stakeholder. The main reference here is to stakeholder salience framework put forward by Mitchell, Agle, and Wood (1997). Stakeholder salience is therefore ''the degree to which managers give priority to competing stakeholder claims in their decision making process'' i.e. how much and which type of attention stakeholders receive from management. The consideration of people engagement and endorsement is here observed in the light of stakeholder management.

5 Conclusion and research agenda

Far from being an exhaustive literature review, this paper has explored for insights and research areas in the managerial domain. Starting from a simple

keyword research, we found three interesting areas to develop from a managerial perspective. A first one is related to the issue of power and equality that looks coherent with the critical management agenda (see for example Hodgson and Cimcil, 2006) both from a methodological and theoretical point of view. A second one is related to the concept of social space as a construct to adopt in order to enlarge the alternatives in the evaluation process. Finally, the third one was connected with the role of technology and social media, and broadly speaking with considering people management in the light of a stakeholders approach.

The aim of the authors is that these preliminary findings can inspire further and deeper research on these topics, looking for and integrated approach to include all of them into a cohesive framework for managing the social pillar in megaprojects management.

Further research agenda will include a systematic literature review on the topic and, following, a set of questionnaires to be submitted to a large set of megaprojects' stakeholders in order to validate the findings.

This paper is a first attempt to open up a discussion on a variety of issues (such as new frameworks that emphasise the social pillar in sustainable project management, the marginalized role of local communities in a context of increasing capitals and political concentration, the development of a common and comparable set of indicators that may help the understanding of the value distribution among (local) communities) that are still marginalized in the mega-project literature.

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Driving Smart Urban Innovation

Mauro Romanelli

University of Naples Parthenope
Department of Business and Economics
Via G. Parisi, 13 80132 Napoli

Abstract

Cities of tomorrow are planning smart urban future, using information and communication technologies to support smart urban innovation by fostering collaborative processes in order to drive sustainable urban growth and improve the quality of life. Cities are becoming smart innovative communities, adopting a smart city framework to urban planning and development. A smart city helps to shape the city of the future as an engine of urban innovation. Sustainable urban future relies on smart cities and communities that support urban innovation for good life, promoting collaborative and multi-actor innovation, following a human-centred approach to smart urban development. As organisational and collaborative spaces, cities are rethinking the urban planning for sustainable future, promoting a smart city vision and developing a smart community. As smart innovative communities, cities are driving smart urban innovation, rethinking the urban future, and planning a smart city view in order to support sustainable growth and construct a wealthy urban future.

Keywords – Urban innovation, Smart cities, Smart communities

Paper type – Academic Research Paper

1 Introduction

As smart communities, cities of the future employ technologies to drive urban innovation and support sustainable growth, improving the quality of life within urban ecosystems and communities (Nam and Pardo, 2011a; Eger, 2005; Martinez, Mikkelsen and Phillips, 2021; Paskaleva, 2011). Cities are constructing a wealthy future, developing a smart city vision and supporting smart community development for collaborative and multi-actor innovation (Sørensen and Törfing, 2018; Fernandez-Anez, Fernàndez-Guell and Giffinger, 2018). Smart innovative cities enable urban communities to achieve competitiveness and sustainable urban development (Paskaleva, 2011).

City development should be intentional (Knight, 1995). Cities are rethinking the urban planning, by adopting a smart city vision to urban development, leading to "cities becoming cities", and following bottom-up processes and fostering community-led initiatives (Komninos, Kakderi, Panori and Tsarchopoulos, 2019). Smart cities extensively make use of information and communication technology to improve the quality of living to its citizens (Yigitcanlar, 2017). Sustainable urban development relies on cities that are selecting a «proactive strategy to develop sustainability» (Roseland, 1992, p. 9), and drive future cities to support community engagement, innovation, cultural diversity, and technological advancements in order to ensure the wellbeing of citizens and achieve urban sustainability (Khan and Zaman, 2018). As smart communities, cities support innovation for improving local competitiveness and high quality of life, tracking a pathway for sustainable urban future and communities (Appio, Lima and Paroutis, 2019; Ahvenniemi, Huovila, Pinto-Seppä and Airaksinen, 2017; Nilssen, 2019).

Cities are shaping sustainable urban futures by using the potential offered by information technology to drive social and community innovation (Yigitcanlar, 2021; Ahvenniemi, Huovila, Pinto-Seppä and Airaksinen, 2017; Yigitcanlar and Kamruzzaman, 2018). Intelligent and innovative cities open up to knowledge-led and technology-driven social innovation and development, driving urban innovation by promoting collaborative and multi-actor processes, involving civil society, research, private/public organisations, and advancing technological and social innovation (Zhang and Wang, 2022; Sørensen and Törfing, 2018; Komninos, 2015; Meijer and Thaens, 2018). City is a net action and collaborative space for innovation and knowledge creation where private/public organisations are involved (Czarniawska, 2002; Nijkamp and Perrels, 1994; Yigitcanlar and Bulu, 2016). Smart city vision shapes the city as a collaborative framework (Komninos, 2015). Innovative cities support collaboration, strengthening the potential emerging from socio-economic and technical systems (Marceau, 2008) within smart innovative urban communities (Caragliu and Del Bo, 2019) and smart urban ecosystems for innovation (Zygiaris, 2013; Palumbo et al., 2021). Smart cities contribute to improving urban competitiveness, quality of life and innovation in long-term horizon (Appio, Lima and Paroutis, 2019; Paskaleva, 2011). The smart city is considered as the hub for global smart society (Joss et al., 2019). Cities select smart, sustainability-oriented social and human-centred innovation focusing on citizen engagement (Tura and Ojanen, 2022), and driving sustainable-inclusive growth, and empowering the citizen to proactively support services co-

production and innovation (Martin, Evans and Karvonen, 2018). Cities of the future design smart human-driven urban communities in order to improve the quality of life (Lazariou and Roscia, 2012). As social incubators of change and innovation for sustainability (Newman and Jennings, 2008), cities are becoming smart communities by adopting a smart city strategy, driving urban change and becoming loci and arenas of social innovation (Shearmur, 2012; Zhang and Wu, 2019; Costales, 2022). Smart cities enable open innovative and collaboration-led communities (Lindskog, 2004; Eger, 2005).

While there are many studies that focus on smart city visions and approaches as a means to drive sustainable urban development, few studies investigate the role of smart city planning and vision as a driver of urban innovation. The research question refers to how cities are rethinking the urban future, designing smart communities as engines of urban innovation. Cities are planning the future of urban development by selecting a smart vision to urban growth and innovation. Three case studies are analysed and presented. Some European cities (Paris, Wien, Florence) are rethinking about the urban future by adopting a smart vision planning in order to shape smart-driven, innovation-led and human-centred, and intelligent communities. Cities adopt a smart vision in order to drive the city of the future, making smart, sustainable and innovative urban communities.

The aim of this study is to elucidate how cities are driving smart urban innovation, rethinking the urban future, and planning a smart city view in order to drive cities as a smart innovative community. Future cities develop a smart city and community vision in order to drive collaboration for sustainable innovation. The paper is structured as follows. After introduction and methodological section, in the third paragraph the theoretical framework on rethinking the future of cities as smart innovative urban communities is elucidated. In the fourth paragraph, the issues emerging from the analysis of three case studies with regards to smart city planning adopted in Paris, Wien and Florence are analysed and presented. Finally, discussion and conclusions are outlined.

2 Methodology

The study employed a qualitative, descriptive and exploratory methodology to analyse how cities are rethinking their future development, by promoting urban innovation to shape smart urban communities. While cities are planning to

transform urban environments into smart cities as an urban policy priority, they are rediscovering the smart city as an opportunity to drive social innovation, shaping smart innovative urban communities. In Europe cities are rethinking about the urban planning and adopting smart city strategies to improve urban quality of life and achieve urban sustainability, promoting multi-actor and stakeholder involvement (Yigitcanlar and Teriman, 2015; Yigitcanlar *et al.*, 2019). As engines of urban innovation and socially inclusive growth, some European cities are rethinking the urban future, adopting a smart city vision and framework to urban innovation and growth, revitalising the city as a community, employing technology as an enabler of urban, social and collaborative innovation, and shaping collaborative urban spaces as drivers of value creation and prosperity in the long-term. The study focuses on three case studies, Paris, Florence and Wien, which refer to cities that are rethinking their urban future and redesigning the urban development planning by adopting a smart city strategy in order to promote the city as innovative, sustainable and inclusive community. These illustrative cases are used to explore a phenomenon that is still in progress, happening and emerging in contemporary times. The smart city frameworks reported illustrate the attempt to shape a smart inclusive city as an innovative community. Following Yin's (2009) guidelines, this methodology aimed to provide a comprehensive understanding of the phenomenon at hand without the rigidity of a predefined structure for observations and analysis. The study follows a multiple case study methodology. A case study refers to an empirical inquiry to investigates a contemporary phenomenon, whereas the boundaries between the phenomenon and the context are not clearly evident (Yin, 2009). The research methods involved case selection and data collection from policy documents. In particular, smart city strategy framework (*Paris Smart and Sustainable Looking ahead to 2020 and beyond*, *Firenze Smart City Plan* and *Wien Smart City Strategy Framework*) adopted by the municipalities of Paris, Florence and Wien as policy documents are considered information sources to collect and analyse data and information, and to investigate how some European cities are rethinking and planning their urban future development coherently with a smart city view by designing a smart and inclusive community as an engine of urban innovation and social growth. A descriptive case study research was employed for the qualitative analysis of the smart city strategy adopted by municipalities to make the city as smart city and community. Investigating strategic choices regarding smart city strategy design helps to understand the pathway cities are following in building

their urban future (Angelidou, 2014; Angelidou, 2017; Mora and Bolici, 2017; Sancino and Hudson, 2020).

3 The future of cities as smart innovative communities

As organisational space (Knox, 2010), the city is «a space or 'assemblage' which brings together various actors to pursue their own objectives» (Zhang and Wu, 2019, p. 151), becoming an arena of innovation (Zhang and Wu, 2019). As smart cities and communities, cities are driving inclusive and healthy growth, developing innovation by fostering multi-level and multi-actor collaborative processes (European Commission, 2017; European Commission, 2012), and shaping sustainable, resilient and inclusive urban communities able to ensure good quality of life coherently with the *UN 2030 Agenda for Sustainable Development* and the *New Urban Agenda*.

Cities are rethinking smart urban planning by focusing on citizen engagement and supporting sustainability-oriented, social and human-centred innovation (Tura and Ojanen, 2022). Developing a smart city vision leads to urban innovation (Nam and Pardo, 2011a) and supports community development (Allwinckle and Cruiskshank, 2011), shaping smart communities for citizen satisfaction and well-being (Silva, Khan and Han, 2018), and improving urban environment, economy, living, mobility governance and education (Giffinger *et al.*, 2007). Sustainable urban development relies on cities that adopt a smart city vision and contribute to public value creation and innovation (Pardo, Gil-Garcia, Gascó-Hernández, Cook and Choi, 2021; Paskaleva, 2011; Nam and Pardo, 2011a). According to Gil-Garcia, Pardo and Nam (2016) «a smart city should be seen as a continuum in which local government officials, citizens, and other stakeholders could think about the initiatives that attempt to make the city a better place to live» (p. 5). A «smart city is *"a community that systematically promotes the overall wellbeing for all of its members, and flexible enough to proactively and sustainably become an increasingly better place to live, work and play"*» (Lara *et al.*, 2016, p. 9). Yigitcanlar *et al.* (2019) state that «what needed is to make the city itself 'smart' – that includes its people, in other words smart community» (p. 8). A city is going smart by shaping a smart community in order to drive urban innovation to achieve sustainable and inclusive growth (Nam and Pardo, 2011a; Paskaleva, 2011).

Cities support open innovation, using digital technology to improve quality of life and achieve long-term sustainability, focusing on people and human capital

(Paskaleva, 2011; Hollands, 2008), shaping innovation-led and sustainable cities as well as inclusive and people-centred communities (Nam and Pardo, 2011b; Chang *et al.*, 2022).

Urban innovation relates to innovative practices that improve the urban environment. Urban innovation refers to a sociotechnical innovation that involves the use of new technologies and also changes in routines, collaborations, and roles of actors in the public domain. Urban innovation is conceived as «the intentional and proactive process that involves the generation and practical adoption of new and creative ideas, which aim to produce a qualitative change in an urban context» (Meijer and Thaens, 2018, p. 366). The city acts for driving smart innovations (Joss et al., 2019). «A smart city is ICT-enabled public sector innovation made in urban settings» (Nam and Pardo, 2011, p. 186). Urban innovation relies on smart cities that develop information ecosystems to address economic, social and environmental needs, valuing identity and community development (Han and Hawken, 2018). Smart cities are the symbol of technology-driven urban innovation (Mora, Deakin, Reid and Angelidou, 2019). Cities adopt a human-centric view in shaping the smart city as a platform for technological and social innovation (Costales, 2022). A smart city helps to shape the city of the future as an engine of social innovation (Anttiroiko, Valkama and Bailey, 2014). Sustainable urban growth relies on smart future-oriented and open innovation-driven cities and communities that employ human, technological, social and institutional capabilities (Angelidou, 2015; Paskaleva, 2011; Nam and Pardo, 2011a). Smart cities develop innovative and sustainable solutions for wealthy urban growth and prosperity (Bătăgan, 2011).

Cities drive urban innovation by promoting smartness as the ability to attract and mobilize human capital in collaboration with urban actors and stakeholders by using information and communication technologies (Meijer and Bolívar, 2016). As *loci* of smart innovation and innovative milieus, and smart communities (Shearmur, 2012; Nam and Pardo, 2011a), cities contribute to democratic, open and socially inclusive innovation, fostering human-centred and collaborative decision-making processes within community development (Andreani *et al.*, 2019; Lindskog, 2004; Eger, 2005; Bătăgan, 2011), bringing together a range of stakeholders (private, public, no profit sectors, citizens) in interactive arenas to develop new solutions and innovative approaches to urban problems (Hartley, Sørensen and Törfing, 2013), and fostering community and collaborative spaces (Skelcher, Mathur and Smith, 2005).

Smart urban innovation relies on smart communities that support stakeholder collaboration and cooperative processes to improve the urban wellbeing (Nilssen, 2019; Paskaleva and Cooper, 2018), opening to multi-actor cooperation to transform the urban community in significant ways and support community development (Lindskog, 2004; Eger, 2005; Stratigeia, 2012). Driving a smart city vision shapes urban innovation views to community development (Nam and Pardo, 2011b), and helps cities to drive urban collaborative innovation (Meijer and Thaens, 2018), enabling the city as a smart innovative community (Paskaleva, 2011) where citizens promote innovations (Kummitha and Crutzen, 2017).

4 Rethinking and planning smart innovative cities

Cities are planning their future urban development by selecting a smart vision to urban growth and innovation. Rethinking smart innovative cities relies on driving smart city planning and implementation in order to shape cities as smart-driven, innovation-led and human-centred communities. In this study three case studies are analysed and presented. Some European cities are rethinking about the urban future by adopting a smart vision planning in order to support innovation and drive sustainable urban development, shaping innovative and intelligent communities. This analysis elucidates that cities are designing the urban planning, rethinking about the future of urban communities, adopting a smart vision in order to shape the city of the future as sustainable and innovative community by strengthening a collaborative framework, designing urban collaborative spaces that enable various stakeholders to contribute to innovation processes to improve the quality of life of citizens within urban communities.

In the smart city framework *Paris Smart and Sustainable. Looking ahead to 2020 and beyond* the smart and sustainable city is using the potential of information technology to support urban innovation and contribute to improving the quality of life within urban communities. Smartness is a means to drive the city towards a sustainable future and quality of life improvement. The smart city is an open platform and resolutely future driven that supports the experimentation and the development of new innovative services and solutions that improve the quality of life and the wealth of urban environments and spaces. Developing the city of the future means to bring together social, technological and organisational dimensions, relying on a smart and sustainable city shaped on three pillars: the *connected city* (the tool) relies on continually integrating technological advances;

the *open city* (the method) relies on stimulating citizen participation and collaborative projects, and driving innovation by exchanging, sharing and co-creating with researchers, scientist and academics, by transforming public administration, simplifying processes; the *sustainable city* is a place where technology serves people, improving their inclusion in city life by allowing them to be involved in creating public services and policy decision-making processes. Smart innovative cities include people in the city life, bridging the gap between new public services and policymaking, and focusing on cities as effective agents of social change and innovation.

In the *Smart city Wien Framework Strategy* looking at the 2050 the smart city vision develops to enable actions that enhance some key concepts: quality of living, sustainability, prosperity, opportunities for education and workplaces. The role of information technology is to contribute to simplifying the urban life, enabling people to continue professional education boundary less. Shaping smart cities supports urban change processes. Driving smart urban innovation helps the urban future and contributes to social integration and inclusion of citizens within urban communities and supports civic participation (not let anybody down and let people have access to the same degree of participation). Smart innovative cities have to ensure top-level quality of living and focus on social participation and inclusion, safety and security, leisure quality and culture, and support both social openness and cultural diversity, strengthening high degree of social participation to enable urban development and support inclusive and sustainable growth.

In the *Firenze Smart City Plan* cities are living organisms made up of people within the process of urban transformation, leading to intelligent urban communities. Smart urban innovation relies on citizens who are able to play a proactive role in identifying some pathways for urban development and quality of life improvement. In particular, planning a smart urban vision supports the city as an engine of innovation and a community of people able to produce meanings and culture, and to enhance human and civil progress. Promoting smartness relies on using technology in order to make cities more innovative, sustainable and intelligent communities capable to drive innovation, reinforcing social relationships. A smart city refers to a city that is changing and constructing new social, urban, and economic responses to environmental and historical pressures. The smart city plan is an open space for debate, confrontation, exchange of information and knowledge among all urban stakeholders which are interested in

contributing to urban, social and economic development. A smart city master plan helps the city to drive continuous urban sustainable innovation, improve the quality of life within community and relies on distributed and collective leadership and vision. Smart urban innovation relies on promoting collaboration among all the involved stakeholders (public administration, research centres, cultural institutions, businesses, associations, groups, citizens) along the urban value chain. A smart city strategy relies on promoting open innovation by involving the stakeholders and embracing the four *Is*: *integration* of all possible aspects in charge of a municipality's competences and background; *innovation* as the development of innovative services and solutions through digital and interactive information technology; *involvement* as a means to enable stakeholders to identify, plan, share, and implement strategic, long-terms vision and goals; and the *information* relies on the use of information and communication technology as a way to reinforce and consolidate the relationships between municipality and citizens, by monitoring the implementation of urban smart strategy.

5 Discussion and conclusions

Cities of tomorrow are planning their future as well as smart innovative urban communities, and contribute to promoting high quality of life, and achieving urban sustainability, making urban collaborative open spaces, arenas and *loci* of innovation and engines of social inclusion. Smart cities and communities contribute to urban innovation and drive sustainable growth and urban development for better quality of life, driving cities as smart and inclusive communities. As engines of urban innovation and smart communities, cities, therefore, develop the potential offered by digital technologies, moving from a technology-enabled to a community-oriented and human-centric approach, putting the people first, focusing on human and social capital, and community, shaping urban collaborative spaces to drive continuous social and economic innovation, strengthening participation and stakeholders' involvement as a key driver for supporting the city as a collaborative, inclusive and innovation-led community.

Paris sustainable city vision stresses the connected city as a tool, the open city as method and sustainable city as a goal. Wien smart vision relies on use of technology as a means to enhance co-participation, co-decision-making and inclusion as strategic view to urban sustainable development. Florence's smart

city planning focuses on searching for bringing together integration, innovation, involvement, and information. Technology enables citizen and community participation and engagement for continuous innovation for urban sustainability. As engines of innovation, cities are tracking a pathway for future sustainable urban innovation. Smart cities strengthen community participation to drive sustainable innovation. Socially inclusive and technology-led innovative urban communities adopt a human-centred and participative-oriented view to urban growth dealing with technology to make the city as a better place for value creation and social innovation. Cities of the future drive sustainable innovation, understanding the potential of information technology to adopt a human-centered smart-oriented vision to develop the city as socially inclusive, innovation-driven and knowledge-oriented community.

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The Knowledge Cloud: The Availability and Transfer of Knowledge in Museums

Alexandra Zbuchea*

National University of Political Studies and Public Administration
30A Expozitiei Blvd., Sector 1
012104 Bucharest, Romania

Monica Bira

National University of Political Studies and Public Administration
30A Expozitiei Blvd., Sector 1
012104 Bucharest, Romania

Mauro Romanelli

University of Naples Parthenope
Via G. Parisi, 13
80132 Napoli, Italy

Florina Pinzaru

National University of Political Studies and Public Administration
30A Expozitiei Blvd., Sector
012104 Bucharest, Romania

* *Corresponding author*

Abstract

The knowledge-based theory considers that knowledge is the most important resource of an organization, while knowledge management is increasingly more considered a way of ensuring competitive advantage, an effective tool for valorising resources, helping manage change and being more resilient, and determining enhanced performance for organizations. All these aspects are also relevant for effective museum activity. Thus, through three focus groups, the paper sheds a light on challenges and practices that are shaping the environment in which continuity of efforts and sharing of knowledge is ensured amongst museum professionals in Romania. The findings are useful for museum managers to better organize knowledge flows and manage knowledge effectively, while for various museum professionals, they help understand knowledge gaps, the various sources of knowledge available as well as the specific dynamics in the field.

Keywords – Museums, Knowledge transfer, Knowledge acquisition, Knowledge and performance.

Paper type – Academic Research Paper

1 Introduction

Museums are information utilities, knowledge-based and learning-driven, and community-oriented organizations that contribute to value creation (Bagdadli, 2007; Freedman, 2000; Hein, 1998; MacDonald and Alsford 2001), making available and sharing their knowledge with audiences within a cultural ecosystem (Borin and Donato, 2015). Museums are successful organizations by managing effectively knowledge (Freedman, 2000). Knowledge is a critical organizational resource for competitive advantages (Davenport and Prusak, 1998). Knowledge is a core resource for successful museums that create social value within communities. It is the commodity that museums offer. Knowledge is constructed individually and socially through interaction between participants and staff coherently with a constructivist view (Hein, 1998). As knowledge enablers and storehouses of knowledge, museums integrate knowledge, content acquisition and organization to develop application in academic research, exhibition and education for users (Hsu, Ke and Yang, 2006). While museums could be also considered as are knowledge municipalities (Freedman, 2000) and shape knowledge (Greenhill, 1992), legitimizing information and knowledge management (MacDonald and Alsford, 1991), there are still few studies that focus on the relationship between knowledge management and transfer within the museum. Knowledge transfer contributes to competitive advantages. Successful organizations are able to drive and manage effective knowledge transfer. Effective organizations transferring knowledge internally are more successful than those lack knowledge management and transfer. Knowledge transfer has been defined as the process through which one unit is affected by the experience of another one within organizations (Argote and Ingram, 2000). Social capital and networks play a critical role in supporting knowledge transfer. Managing efficiently knowledge transfer relies on organizations managing and building social capital proactively (Inkpen and Tsang, 2005). According to Wang and Noe (2010) knowledge transfer relates to the «movement of knowledge between different units, divisions, or organizations», and «involves both the sharing of knowledge

by the knowledge source and the acquisition and application of knowledge by the recipient» while «knowledge sharing refers to the provision of task information and know-how to help others and to collaborate with others to solve problems, develop new ideas» (p. 117).

This paper is focused on knowledge transfer within the museum world as it seeks to explore various methods and practices employed in the process; it also goes beyond the conventional framework that primarily links knowledge transfer to a process that involves the transmission of knowledge from specialists, researchers and curators towards different external audiences, mainly the visitors (Cranmer, 2016; Navarrete, 2020) and addresses a variety of process taking place under the

In doing so, the first part of the paper is focused on the field literature regarding museums as knowledge organizations detailing the various type of knowledge produced by museums and the management process of knowledge sharing. Drawing upon prior research (Zbuchea and Leon, 2015; Bira and Zbuchea, 2019), the subsequent section presents findings from a qualitative study (comprising 3 focus groups) that aimed to investigate the methods currently employed by museum professionals to facilitate communication and the sharing of skills, experiences, and data. A secondary avenue of research aimed also to identify the main patterns and/or means that are employed when keeping in touch not only with activities and events organized by their peers, but when it comes to actually build upon previous experiences and results. Thus, our study sheds a light on challenges and practices that are shaping the environment in which continuity of efforts and sharing of resources are ensured amongst museum professionals in Romania.

2 Knowledge management in museums. A brief literature review

The relevance of knowledge assets as fundamental strategic factors of business success has been widely recognized in today's competitive scenario (Barney, 1991; Drucker, 1993; Grant, 1991). More and more organizations accredit their competitiveness essentially to their knowledge assets and consider knowledge as the differentiating competitive lever in the knowledge economy (Nonaka and Takeuchi, 1995). In such a prospect, the suitable development and deployment of an organization's knowledge assets have become a strategic decision for its success.

Museums are knowledge organizations, therefore knowledge management could be vital for reaching their missions, providing a way of ensuring competitive advantage, an effective tool for valorizing internal and external dynamics, helping museums cope with change and being more resilient, and determining enhanced performance. All these aspects could be considered for effective museum activity, focusing both on the inner processes and the public activity of museums; knowledge management is relevant for all activities and subsystems associated with museums (Huber, 2003). To be effective, museums should strive to become "knowledge-centric organizations", meaning to be proficient in using collective knowledge to achieve their missions and to view knowledge as a main asset (Vakharia, 2017).

2.1 Typology of museum knowledge

Knowledge management literature considers several classifications of knowledge. Depending on its nature, knowledge can be explicit or tacit. Explicit knowledge is codified in words, numbers, and symbols, and can be stored, analyzed, used, and easily transferred. Tacit knowledge is implicit, consisting of thoughts, experiences, capabilities, and even the intuition of the employees. It is diffuse in museums, and uncodified, sometimes even unperceived. Both tacit and explicit knowledge could be important museum assets, therefore, they have to be properly managed and activated to work for the benefit of the museum's heritage and its beneficiaries. Nonaka (1994) proposed the SECI model to convert tacit knowledge in organizations through socialization, externalization, combination, and internalization of knowledge into explicit knowledge. Most of the knowledge in organizations, including museums, is tacit. To be valorized, knowledge management processes involving discussions, training, even socialization, and enhancing organizational culture, should be designed and implemented in museums.

Depending on its source, knowledge can be internal or external. Organizations tend to concentrate on internal organizational knowledge, being easier to identify, analyze and use. Still, proper knowledge management strategies are needed to handle both internal and external knowledge. The latter might be a relevant resource for museums, extending their knowledge base and leading to diversification of offers and enhanced benefits for museum visitors and communities.

Another classification of knowledge is related to its transferability readiness. Knowledge could be codified or uncodified. The first one is easier to handle, therefore, knowledge management strategies should aim to codify as much relevant knowledge as possible. Knowledge could be also theoretical or applied. Especially museums have a strong capital of theoretical knowledge, the specialty one related to its heritage and domain of investigation. Also, knowledge in museums could be administrative in nature, related to administrative and legal processes associated with museums' activities.

The last classification we mention is concerned with how knowledge is processed by humans. The theory of knowledge fields developed by Bratianu (Bratianu and Bejinaru, 2019) divides knowledge into three categories: rational, emotional, and spiritual. Rational knowledge is explicit and objective, the result of human reasoning. An important part of the rational knowledge in museums is related to the scientific knowledge related to the museum's collections and domains. Emotional knowledge is associated with feelings and emotions. As a form of tacit knowledge, it is difficult to identify and understand, although it contributes to decision-making and stimulates cognition. It also contributes to organizational culture, being an important influencer inside museums, from a practical perspective. Spiritual knowledge is also tacit, related to values, and concerns related to the meaning of life. It provides a sense for organizations and individuals, framing it in a meaningful vision. It might also be connected with organizational culture, organizational learning, knowledge creation, and sharing (Rocha and Pinheiro, 2019, 2021).

2.2 Knowledge management processes within museums

Although knowledge is essential for museums' activities and "museums are shaping knowledge" (Greenhil, 1992), knowledge management is lesser investigated in museums focusing mainly on very specific aspects. Nevertheless, some studies offer a more comprehensive view. Such an investigation aimed to identify knowledge management orientation, its enablers, and its relationship with the organizational performance in museums across the US (Vakharia, 2022; Vakharia and Poole, 2023). It reveals that museums' performance and their ability to create public value are hindered by how they create, manage, and share knowledge. Thepthepa and Mitsufuji (2016) surveyed two national science museums in Thailand and show that knowledge management processes,

especially knowledge acquisition, and dissemination, enhance organizational learning. This study also reveals different perspectives of managers compared with other staff members. Managers tend to perceive knowledge management processes at higher levels. Differences in perceptions between managers and other employees have been identified also by Zbuchea and Leon (2015), with managers having more complex views on knowledge management processes.

Perera and Chandra (2011) point out that knowledge management has long-term significance for museums, helping museums serve their communities and acting as educational forums. The main benefits of knowledge management for museums that were identified are enhanced quality for the museum offer, surpassing visitors' expectations, upgrade museum communities/audience development, and employee development.

Some studies on arts, cultural, and crafts organizations point out a lack of focus concerning the transfer of know-how and skills (Manfredi Latilla et al., 2019), suggesting a low awareness of tacit knowledge in such organizations. Still, knowledge sharing, including formal aspects associated with this process seems to be of high concern in cultural organizations (Zbuchea and Leon, 2015). Also, some knowledge transfer has been documented between higher education organizations and the cultural industry (Cruz et al.2019). Stakeholders and common interests play an important role, in the framework of unstimulating and weak policies in the field. Being part of a network, either social or formal, to share knowledge and increase access to resources is positively approached by museums (Bira and Zbuchea, 2019).

Of wider concern seems to be knowledge sharing for better designing exhibitions and museum offers. Moussouri (2012) points out how knowledge management makes exhibition development more effective, ensuring a user-centered perspective, and valorizing communities of practice. He stresses that sharing of knowledge and learning in museums are social phenomena, involving all types of knowledge. Long-distance collaboration should be successfully mediated by online tools.

We also observe that knowledge management in museums is tightly related to technology and digitalization (Ignjatovic, 2004; Hsu, Ke, and Yang, 2006; Srinivasan *et al*., 2009; Datunashvili *et al.*, 2018; Romanelli, 2020). Technology facilitates access to museum heritage and its online valorization (Häyrinen, 2012). To properly manage these activities, be updated with the new technologies, and positively react to their new challenges, there is a continuous need of improving

the technical skills of its employees (Hess et al., 2019). Also, even medium-sized museums are aware of the importance of information infrastructure, of processes associated with knowledge sharing, to connectivity, that they set up a routinized formal information exchange (Huvila, 2013).

Information systems are vital for museums from many perspectives, the most important one is related to collection management. But museums are increasingly aware that their information management system should serve more, and the organization overall, contribute actively to achieving its mission. For proper systems, integrated with wider knowledge management strategies, museums should consider also the needs of various stakeholders for successful knowledge transfer and cooperation (Kavakli and Bakogianni, 2003; Neves et al., 2021). Not only knowledge sharing, transfer, and valorization are enhanced through proper systems, but other backstage activities, vital for heritage, could be supported by effective knowledge management – as in the case of conservation (Moraitou and Kavakli, 2018). Various studies also stress the importance of adapting/choosing the right software and approach, to satisfy the specific needs of heritage management (Hervy *et al.*, 2013, 2017; Neves et al., 2021).

Digitalization and new technologies facilitate several of the processes associated with knowledge management: acquisition, storage, sharing, and utilization. Knowledge management processes are useful tools contributing to designing effective knowledge management strategies. They are usually classified into acquisition and creation of knowledge, storage, and protection of knowledge, sharing of knowledge, and utilization of knowledge.

Knowledge acquisition and development influence the quality and the outcomes of museums' activities. Knowledge can be created or can be harvested both from internal or external resources, through sharing. Within the museum world, knowledge utilization and transfer are mostly approached in the classical framework of this cultural institution, which considers the transfer from specialists, researchers, and curators towards different external audiences, mainly visitors (Cranmer, 2016; Navarrete, 2020).

3 Managing and transferring knowledge with the Romanian museums

3.1 Methodology

Building on previous research (Zbuchea and Leon, 2015; Bira and Zbuchea, 2019) the current paper aims to further explore the mechanisms currently in use when ensuring the communication and transfer of skills, experiences, and data amongst museum professionals. The current research aims also to identify the main patterns and/or means that are employed when keeping in touch not only with activities and events organized by their peers but when it comes to actually building upon previous experiences and results.

Qualitative investigation is appropriate considering these objectives.

The focus groups are organized around three distinct categories of people working in museums. The groups are therefore composed of representatives of museum management (group 1), museum educators or assimilated personnel (group 2), and other museum professionals (group 3). The research results are organized around two main themes, namely: how the availability of knowledge is constructed and perceived by those involved in museum educational activities and how is the knowledge transfer formally organized, implemented, and monitored.

3.2 Findings and discussions

3.2.1 Sample

The current research was organized in April, on a convenience sample of 17 respondents, organized in three groups: the first group, N=7 consisted of people with management attributions (general managers or department managers); the second group comprised museum educators (N=5), meanwhile the third was composed by people with roles as researchers, curators, specialists and / or support activity (e.g. communication and associated domains). As work experience, including the length of activity within the domain and job roles, is significant in how individuals perceive their involvement in knowledge sharing and acquisition, participants to this study form two equal groups around the following categories: mid-career professionals (over 15 years of experience, N=4) and professionals having a consistent experience (5-10 years, N= 4). A small

number of participants were in the early stages of their career within the field (under 2 years of experience, N=3 and 2-5 years of experience, N=2), while only one participant was nearing the end of their career. This being said, it is also important to keep in mind that participants in these focus groups had various background, both in terms of academic training and previous work experience, prior to museum activity. Equally important for the process of knowledge management is the number of employees; in this study, most participants belonged to small museums, between 10 and 50 employees (N=7), meanwhile those hired in organisations over 100 employees were 5. Only 3 employees belonged in medium size museums, with a number of employees between 50 and 100 employees.

3.2.2 Findings

The themes that emerged during focus groups gravitated towards two main issues (1) defining relevant knowledge (alongside its sources, production and acquiring mechanisms) and (2) knowledge transfer (amongst colleagues within museum but also transfer towards outside – visitors, children -during education program- and partners).

When discussing about what is knowledge from the viewpoint of the current activities in a museum, one of the main differences occurred along the lines that separated groups according to their activity type (management, education, research & specialized support activities – e.g. communication, restauration). As expected, each group had similar definitions and shared several common views in accordance to their main activity. Managers often view networking skills and the ability to take an interdisciplinary approach to managing a museum as crucial competencies. As one participant to the focus group said: "it is important what you find out from people next to you, is important to talk to people over a coffee or a drink, to find out useful information to your future career" (S4, ≥15 years in the domain) or, as another participant expressed: "to communicate (….) to interact, to adapt to those we are work together with" (S2, 5-10 years in the domain).

During the focus group, participants identified that having knowledge and expertise in management was crucial for success. This included understanding the procedures and processes within an organization, as well as the legal requirements when working with museum objects and the public. Both experienced managers and those who were new to working in museums

acknowledged the importance of being acquainted with formal rules and legal regulations, albeit from different perspectives and with different aims. However, one participant also pointed out the inconvenient of relying too heavily on procedures as they can hinder communication instead of facilitating a smooth exchange of information. Peer learning was also mentioned in relation to knowledge about communication protocols and procedures; thus, formal study or trainings on procedures and formal regulations slid towards a more informal activity of sharing knowledge. Navigating the internal flow of communication and interacting with support departments (such as accountability) was mentioned within the context of information management, procedures and protocols. A challenge especially to those in their early career stage, an efficient communication by the rules is also dubbed essential for people in their mid-career.

Participants also emphasized the importance of having a deep understanding of the museum domain (such as history, arts, natural history etc.) within the broader context of a public institution interacting with various stakeholders. This view was shared by all respondents, although those working as museologists mentioned it more frequently. Knowing the "theory by the book" is deemed essential for professionals regardless of their specific field of activity (research activity, curating an exhibition, communicating about programs and activities etc.). As one participant expressed the need to acquire expertise in the domain: "understanding the domain is the minimum required and more knowledge is always helpful; however, since it is impossible to know everything all at once, form the beginning, one must have the capacity to research and learn (...) ".

It was also noted that constantly updating one's knowledge is paramount for a museum activity. Understanding knowledge as a set of information that should be constantly enlarged and updated, alongside with the need to improve skills and know-how was addressed by most of participants. In all groups, participants mentioned the importance of gaining theoretical and practical information in the context of formal learning, on the background of limited funding available for training and lifelong learning activities for museums specialists in Romania. If managers considered the topic from the viewpoint of enabling an organisation to move forward and respond to stakeholders' expectations, other museum specialists referred to formal learning as opportunity to exchange, build a network and getting to know people facing similar challenges / difficulties.

A good English command is implicitly assumed by participants when discussing the various information sources (e.g. publications in English) they used to keep track of museum novelties and innovations. It is basically a sine qua non pre-condition to access the most recent information related to museums. Largely acknowledged and discussed by museum educators, knowledge access via English is, definitely a barrier when it comes to knowledge sharing since, in Romania, BA programs usually include one or two semesters of studying a foreign language, and therefore museum professionals in domains such as history, art history, natural history, ethnography heavily rely on previous knowledge from high school or on independently acquired knowledge.

4 Conclusions

Vårheim and Skare (2022) show that museum-related investigations are limited in the mainstream academic literature, and case studies are predominant, while most of the research is focused on museums' beneficiaries and communities. The investigation confirmed the low interest in knowledge management in the museum sector both considering the academic investigations, and the practice within museums. It also proved a more consistent interest in practical aspects, compared to providing a conceptual framework in the field. Most of the academic attention has been focused on information systems within museums, digitalization, and the impact of new technologies on museum knowledge and activities.

In the specific case of the Romanian museums, the study suggests that specialized knowledge (whether it is in the general domain of the museum – e.g. history, arts etc., in specific domains of activity e.g. social media communication) is still considered among the most important type of knowledge. Another important set of knowledge relays also on specialized know-how, but it regards stakeholder interaction and communication, namely the visitors (or participants to educational programs).

The findings are helpful for museum managers to better organize knowledge flows and manage knowledge effectively, while for various museum professionals, they help understand knowledge gaps, the various sources of knowledge available as well as the specific dynamics in the field.

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Fostering Digital Transformation and Business Model Innovation of SMART Tourism Ecosystems: Opportunities and Challenges

Francesco Santarsiero*

Department of Matematics, Computer Science and Economics
University of Basilicata
Via dell'Ateneo Lucano, 10, 85100, Potenza - Italy

Daniela Carlucci

Department of European and Mediterranean Cultures
University of Basilicata
Via Lanera, 75100 Matera - Italy

Antonio Lerro

Department of Matematics, Computer Science and Economics
University of Basilicata
Via dell'Ateneo Lucano, 10, 85100, Potenza - Italy

Giovanni Schiuma

Department of Management, Finance and Technology
LUM University Giuseppe Degennaro
S.S. 100 km 18 – 70010 Casamassima (Bari) – Italy

Rosaria Lagrutta

Department of European and Mediterranean Cultures
University of Basilicata
Via Lanera, 75100 Matera - Italy

** Corresponding author*

Abstract

The paper aims to analyze academic literature in the field of digital transformation and business model innovation, with particular reference to the tourism sector, in order to identify challenges, opportunities, and policy directions for stakeholders in the industry to be able to face the challenges of the current socio-economic scenario and gain a

sustainable and lasting competitive advantage, as well as to activate development dynamics in the territory. In the digital era, the competitiveness of organizations depends on their ability to adapt and innovate business models to market trends and changing stakeholder needs. These innovations cannot neglect digital dimensions, which have become even more essential after the pandemic situation. However, innovation is not an easy process and presents many risks and barriers, particularly in the tourism sector, which is considered a labor-intensive production sector where the competitive advantage depends on the differentiation of the tourism product and the humanization of the experiences offered. As a result, tourism is often hesitant to embrace digital transformation, fearing it will lead to standardization and loss of appeal to the end customer. Despite the growing relevance of this topic, especially in the wake of the Covid-19 pandemic, there has been little exploration of ways to support tourism and cultural organizations in embracing digital innovation journeys. This paper, thus, identifies challenges, opportunities, risks, and needs for tourism organisations involved in digital transformation and business model innovation processes, and propose policy recommendations and future research directions to support their transformation of those tourism organizations.

Keywords – Digital Transformation; Business Model Innovation; Tourism

Paper type – Academic Research Paper

1 Introduction

The process of Digital Transformation (DT) is crucial to track, because the most relevant socio-economic and labour-market arising impacts are innovating the business models, through the transformation of work, processes, services, products, as well as the paradigm of the whole economy (Muro et al., 2017). At the centre of this impact, there is digital technology (e.g. Big Data, Analytics, Artificial Intelligence, etc.) that contribute to the improvement of workers' abilities and companies' effectiveness. The integration of emergent technology in the company's routines alongside the employees instead of in their place should contribute to the increase of knowledge creation and management dynamics. This, allowing workers to dedicate more time to added value processes rather than consuming and alienating ones. It follows that technology is, even more, resulting as a driving force of today's competitive landscape. Therefore, DT, Business Model Innovation (BMI), and the processes to implement technology in the right way to produce innovation are current almost mandatory topics for organizations' competitiveness and survival.

In this regard, in this chapter, desk research in the fields of DT, and BMI has been carried out to identify challenges, opportunities and organizations' risks and needs, with a particular emphasis on tourism organizations.

The chapter is structured as follows. The second paragraph analyzes the DT concept, paying attention to the state of the art, definition, critical process' stages, challenges, and the situation in tourism. Then, the third paragraph focuses on BMI. The research concludes with discussions about how to support and foster DT and BMI in tourism organisations.

2 Digital Transformation in Tourism

Digital transformation (DT) is a buzzword that has been around for several years, and it is gaining momentum as companies strive to stay relevant in the digital age. According to Capgemini, DT is defined as "the use of technology to radically improve performance or reach of enterprises" (2011, p. 5). Digital tools and innovations, such as smart devices, mobile apps, analytics, social media, and more, are tested and employed by a growing number of enterprises interested in improving efficiency in customer relationships, internal processes, and growth strategies (Westerman et al., 2014).

The impact of DT can be seen in almost every sector of society, affecting economies, improving processes, and fostering networking opportunities between different actors (Schallmo et al., 2017).

From the 2000s, the fast development of smartphones, digital devices, and social media platforms radically changed the ways of interaction between customers and companies. Customers used to spend more time online, and they are connected on a multi-channel base, producing and sending data through the interaction with the web. Their needs and habits are changing, as well as the ways and speed of exploiting goods. Companies have been encouraged to develop and test new approaches and methods to communicate with consumers on an individual basis and often in real-time, as well as to gather data to understand their desires and behaviors. Digital innovations like chatbots, AI, analytics and more, have been introduced to contribute to the above-mentioned purposes.

As a consequence, the digital presence of companies actionable through internal DT journeys and digitization of products and processes is becoming mandatory for organizations aiming at staying relevant and keeping the pace of change in the current business scenario. The customers' expectations have

radically changed as well. The fast development of digital technologies and solutions raises the efficiency standards, increases the speed of market dynamics, and decreases the product lifecycle (Schiuma, 2012). Moreover, consumers are evolving into prosumers not more interested only in the buying process. They look for experiences and want to get a central position in the process, so they aim at getting engaged in co-creation processes of products, services, and experiences.

Therefore, innovation rapidly and easily becomes quite common and replaced by new emergent innovative digital solutions based on technological advancements and that meet even better the customers' needs. It follows that organizations operating in such mutable and unpredictable digital ecosystems have to become resilient, proactive and able to evolve in the same way the competitive landscape does. To do so, it is relevant to consider that the broader goal of DT is not to digitize the company. It is more related to the generation of growth (Suh et al., 2018).

In conclusion, DT is not just about implementing new technologies; it is a process that involves the entire organization, requiring skills, competencies, and a shared vision.

In the tourism industry, DT offers numerous opportunities for growth, increased efficiency and productivity, competitive advantage, and innovation. Specifically, DT can lead to the development of innovative tourism offers, destination management, the customization of products and services, the creation of new tourism packages, and the provision of policy guidelines for local tourism ecosystems (Dredge et al., 2018, p. 6).

Compared to other sectors, the tourism industry presents a fragmented offer, and its sub-sectors are inherently labor-intensive, characterized by humanization and direct client contact. As a result, the industry is often reluctant to innovation and digitalization (Meyer and Mayer, 2015). Additionally, sub-sectors within the tourism industry vary in terms of resources, access to finance, skills, culture, and other factors. Therefore, achieving DT in tourism organizations can be a complex and challenging process.

To ensure an effective DT process in tourism organizations, a holistic vision that involves the entire sector is necessary. Three key phases can be identified regarding the transformation of the sector based on the evolution of technologies (Xiang and Fesenmaier, 2017). The first phase involved the diffusion of the Internet from 1990 to 2000. During this phase, technologies were used as

supporting tools for the incremental improvement of internal operations. The digitization of tourism offers began with the creation of websites to replace traditional paper-based catalogues. At the same time, reservation and distribution systems became web-based, making online transactions easy and facilitating the growth of the industry.

The second phase saw the consolidation of digital business ecosystems between 2000 and 2010. With the help of technologies, travelers became more informed and aware of their needs. Virtual marketplaces proliferated to allow customers to become the protagonists of their travel and influencers for future travelers. OTA replaced traditional agencies, and innovative startups like Airbnb and TripAdvisor entered the market in a disruptive manner.

The last and current phase, which began in 2010, coincides with the development and spread of cloud computing, Virtual Reality (VR), GPS, wearable technologies, and other technologies that allow a real-time integration between digital and physical worlds. The combination of traditional tourism offers with web and social media platforms offers relevant opportunities to develop new products and services, innovate, create new business models, and guarantee growth and sustainable advantages to resilient and proactive organizations that are aware of market change and ready to adapt their business.

The emergence of DT in tourism has led to the need for new ways of planning and configuring destinations. This includes the development of new business models, value chains, and ecosystems, as well as evolved and new roles for customers, producers, and tourism organizations in general. In addition, the interconnection between physical and digital worlds has allowed for the reimagining and customization of visitor experiences, which is particularly relevant for second-rate destinations that are victims of the fragmentation of the sector.

This requires a holistic vision that contemplates and engages the entire sector to ensure an effective DT process in tourism organizations. The success of digitalization in the tourism sector ultimately depends on the capacity of the sector to share, learn, and collaborate.

In conclusion, the evolution of technologies has resulted in a transformation of the tourism sector, offering significant opportunities for growth, innovation, and competitiveness. However, it also requires organizations to be resilient, proactive, and adaptable to market changes. Those who have proven to be aware of the context and visionary have entered the market in a disruptive way, while those

who have ignored this reconfiguration have been replaced or pressured to reconfigure their businesses. In definitive, an effective and targeted DT require "a collaborative network and learning environment be established so that SMEs can be inspired by technology-savvy businesses both in and outside tourism and can learn and collaborate together" (Dredge et al., 2018, p.10). Moreover, technologies and digital innovation even though they can be new, they rarely impact radically on a market or ecosystem. What has the potential to be radical and disruptive is the way by which they are exploited. So, the logic behind technologies and the business model deriving from their usage and application. Hence, the concept of BMI.

3 Business Model Innovation in Tourism

In an increasingly digital world, BMI is crucial for companies that wish to remain competitive. The rise of digital technologies has enabled new business models to emerge at an unprecedented pace, creating opportunities for companies that can adapt quickly and innovate. For instance, digital platforms like Uber and Airbnb have disrupted traditional industries by creating new business models that utilize technology to create new markets and services.

However, implementing BMI can be complex and challenging, requiring a deep understanding of strategic goals, the competitive landscape, and customer behavior. The process entails analyzing existing business models, identifying areas for improvement, and developing and testing new ones.

There are several drivers of BMI, including technology, customer behavior, and competition. Technology is a significant driver of BMI since it enables new products, services, and processes that can transform the way organizations operate. Customer behavior is another essential driver of BMI since customers increasingly demand more personalized and convenient services, forcing companies to adapt their business models to meet these changing needs. Additionally, competition is also a driver of BMI since new players entering the market can disrupt traditional industries, necessitating changes in business models to remain competitive.

In the tourism industry, BMI has become increasingly important due to the impact of DT on the sector. Considering the study by Linton and Öberg (2020), who focus on digitalization and destination location as relevant contextual factors, they define typologies of business models in tourism organizations,

developing a framework distinguishing four types of tourism business models (Figure 4). The first typology is defined as 'Bricks and Mortar,' which calls to mind the features of the traditional and homonymous tourism business model (Livi, 2009). That is the case of those organizations established in an attractive destination representing, for tourists, the reason for the travel. The proximity to attractions or dedicated facilities is the base of the business model. Services and activities provided are the traditional ones, as the accommodation, incoming, and those related to the management of tourists' experience. Therefore, digital capabilities are not required.

Instead, in areas where tourists usually are not attracted, organizations with medium digital capabilities may develop based on a 'Create-a-destination' business model. This kind of organization develops the business in high-potential areas that are still out of the usual tourists' itineraries. Therefore, the attractiveness depends on the ability of the organization to communicate value propositions and offers, as well as the capacity to provide unique experiences that become the primary reason for travel. It may be the case of those hotels that offer unique experiences, like ice hotels, tree houses, and so on.

The third typology of business model is related to those organizations that are not located in tourist areas but may be involved in tourism activities due to the high digital capabilities they possess. The 'Intermediary' business model includes P2P and digital activities. Therefore, organizations act as digital platforms fostering interconnections between travelers and destinations. Typical examples of this typology of companies are booking platforms like Booking.com, TripAdvisor, and so on. Moreover, with the arising of the Sharing Economy business dynamics, have been changed to the advantage of co-creation and tourism engagement (Schor, 2019). As a consequence, new platforms have emerged to connect customers and service providers to co-create experiences and tourism offers.

The last business model is that of 'Digitalized destinations,' namely destinations characterized by organizations with high digital capabilities that are interconnected in a digital ecosystem. These organizations offer advanced tourism experiences that are often integrated with advanced technologies such as big data, analytics, IoT, smart devices, and so on, distinguishing the concept of smart tourism (Gretzel et al., 2015). The critical activities are related to the collection, analysis, and representation of data. These activities allow increasing the understanding of customers' needs and habits, to adapt the offer with even

more customized products and services, as well as to guide management decisions. At the same time, core activities are related to the provision of innovative experiences that should act as attractors and differentiating factors (Chesbrough, 2007).

Once assumed the possible tourism business models, it becomes relevant to consider the business goal that in tourism, as in the other sectors, is related to the value generation achievable through the improvement of performance, the understanding of the competitive landscape, and the development of products and services even more attractive.

BMI should be pursued with different paths for each identified typology of business model, but it is recommended not to neglect DT. Digital capabilities can contribute to the development of new concepts of destinations, impacting more than just attractiveness. Therefore, business models based on digital capabilities should be considered one of the main goals for tourism organizations.

In conclusion, BMI is crucial for tourism organizations to remain competitive in a constantly changing landscape. Digitalization and destination location are two contextual factors that determine the typology of business models that can be adopted. By considering the value drivers of novelty, efficiency, complementarity, and lock-in, tourism organizations can identify the path towards successful BMI. The integration of DT is essential to achieving a good positioning in the market and satisfying the changing demands of tourists in the Digital Era and the age of Smart Tourism.

4 Challenges for Tourism Organisations

The capacity to innovate represents one of the most relevant factors determining the development of a productive sector. Looking at a global scenario where the demand is evolving, the tourism flows are changing, the average age is growing as well as the income, and the sustainability's challenges are becoming even more pressing, new technologies and new digital innovation in general, are modifying the supply chain heavily (Fereidouni and Kawa, 2019). Data about technology and digital innovation implementation in tourism companies are encouraging due to the growing number of organisations who have implemented ERP (Enterprise Resource Planning) and CRM (Customer Relationship Management) systems. These data record a growth of 18% and 11% respectively, in the Italian tourism sector (Dredge et al., 2018). However, at the same time,

digital innovation is interesting companies, mostly in terms of digitalisation and digitisation rather than DT. Indeed, coining the term provided by Westerman et al. (2014), few are the 'digital master' tourism organisations.

However, innovation in tourism includes aspects that go beyond the mere concept of technology innovation, namely the ability to develop or innovate a business model to exploit new technologies and to adapt the business to the emerging trends (e.g. sustainability, co-creation, prosumerization, etc.), as well as the attitude to manage and develop new innovative solutions to keep the pace of change (Gimpel and Westerman, 2012). Therefore, DT and BMI are vital challenges to look forward.

However, what is the real scenario of the tourism sector? Furthermore, why, how, and with which results, tourism organisations approach to DT and BMI?

Considering the study by Dredge et al. (2018) that examines the challenges and opportunities of digital innovation in tourism, the reasons leading organisations to approach to DT may be grouped into five categories.

The most relevant are those related to the search for improvement of the web presence and the growth opportunities. Then, other reasons are those related to the potential of digital innovation to exploit future opportunities and to find new solutions to face the seasonality as one of the critical challenges for tourism businesses. Then, the will of improving networks.

These reasons highlight the optimistic perception of digital innovation. Organisations seem to consider DT as a powerful solution enabling growth and performance improvement, in terms of cost reduction and satisfaction of the demand. Moreover, the willingness of improving networks reflects the importance that organisations pay to relationships, supply chains, and the establishment of a dialogue with the ecosystem's actors and customers.

Furthermore, organisations approaching DT and more in general Digital Innovation believe that investments on technologies will return in terms of the following typologies of benefits: Customer acquisition; improve online brand visibility; expand international reach; improve service quality; increase visitor satisfaction (Dredge et al., 2018).

In this regard, it is possible to state that DT enables BMI and the generation of new business models. Moreover, the careful implementation of digital innovation may improve the quality and accessibility of new products, services, and experiences.

In the specific, successful implementation of digital innovation in tourism may occur in examples of the resolution of problems like crowding or social distancing, especially during the Covid-19 pandemic. Mobile apps equipped with GPS or live assistance may suggest new, unusual and less beaten tourist paths. These solutions may also result in strategies to value rural areas, to generate new tourist destinations and/or to safeguard the cultural heritage (UNWTO, 2020).

Another relevant aspect coming out of Dredge et al. (2018) is the distinct organisations' attitude to digital innovation based on the internal levels of digitalisation. Organisations with a low level of digitalisation are only interested in improving internal processes and productivity. On the contrary, organisations with an adequate level of digitalisation, and so, those who have already experimented digital innovations implementation are aware of the resulting potential and impact. Therefore, they are interested in increasing the level of trying to pursue BMI to find new opportunities and generate innovative solutions.

It follows that a sort of roadmaps towards the complete digitalisation is pursued. However, a lack in terms of awareness of DT and innovation potential emerge as well. From the analysis emerged that the same awareness is an aspect that is developed ongoing. In fact, from the second step, organisations seem to be more open to understanding the potential of BMI, and they aim more frequently to extend and scale the business to a global level.

In this regard, it appears that the DT is more like a journey that requires a structured and gradual roadmap rather than an instant implementation. However, this is not an easy process, and it hides various risks, difficulties and barriers. The first of which is the lack of plenty of awareness of DT potential. It is indeed gained during the process exploitation. This, however, denotes a barrier deterring organisations, SMEs in particular, to program such investments.

In the following, a focus on the relevant barriers to digital innovation is proposed.

Freidouni et al. (2019) in their research, identify three main categories of gaps, linked to technology, productivity and regulatory.

The impact of digital innovation and technology advancement is acknowledged (Hinings et al., 2018; Schiuma, 2012). Latest inventions and the fast technological progress of the past years contributed to improve performance, reduce costs and waste, enhance communication, as well as the management. However, if technological progress has a positive impact on the market side, for companies, it may become a high barrier. Quality standards become higher; competitiveness is

rigid. Therefore, digital technologies became a dependency, a discriminating factor without which is even more challenging to compete. The required large investments penalise SMEs in particular and accentuate most the digital divide between large and small companies. The same logic is replied in the tourism destinations scenario. There, small and secondary destinations denote more difficulties in keeping the pace of change and implementing required digital solutions.

This divide is moreover accentuated by the ability to manage data and knowledge, that in the current business landscapes, are the factors which are influencing most the productivity (Carlucci et al., 2004; Schiuma, 2012). Tourism digital platforms, for example, have entered disruptively the market thanks to their capacity to manage data and orient decisions to meet the demand better. Therefore, companies, as well as destinations, that will continue keeping a traditional management system ignoring the change in demand, context and processes, will be locked out of the market. The World Economic Forum (2019) in fact, estimates a loss of 940.000 jobs in the hotel industry in the next ten years due to change in consumers behaviours. Travellers prefer apartments and short terms of staying rather than a traditional hotel. Therefore, without the innovation of business models to adapt businesses to the new demand, the whole industry will suffer from a massive crisis. In this regard, the recurring to digital platforms or tools, allowing the analysis of data may support companies in anticipating trends and adjusting the offer before the crisis.

Ascertained the strategic relevance of DT, the difficulties in implementing this process are sometimes accentuated by the regulatory system that does not follow the same pace of technological progress. New services made possible by new emerging technologies are not yet disciplined by the law because they are facing issues never treated before. Therefore, some services are perceived as dangerous, and their development is heavily slowed down.

On the contrary, for relatively new services like the e-commerce whose regulatory has been disciplined, rules appear stricter and challenging to be followed by the SMEs that are so forced to desist in strengthening their turnover.

Another relevant obstacle on which SMEs, in particular, occur and that is strictly related to the lack of awareness of the potential of DT, is the need for training to learn how to exploit and manage a new technology once it has been introduced in the company (Dredge et al., 2018). New technologies require dedicated technical skills and competencies that often SMEs lack. So, training sessions are

necessary to understand how technologies work, but at the same time also to approach the right technology and to divulge it, as well as involve the entire company in the implementation and diffusion process. Therefore, the training should be considered as a deterring barrier for organisations that also lack time and finance to execute this activity.

Especially when a company does not understand the importance and potential of DT, it perceives the expense required as a cost rather than an investment. Then, considering that SMEs, often family-run highly populate the tourism sector, the lack of financial resources joined to the lack of awareness and knowledge on this topic are the biggest stumbling block.

Besides, these obstacles are followed by the 'We have always done in this way' syndrome (Zimmerman, 2019) that affect those companies who believe that their current level of digitalisation is enough. Companies declare that, without any analysis or benchmarking activity.

This is an intangible obstacle that may have a crucial impact on organisations who do not have a clear vision and lack of context analysis. This because the real key challenge for companies is business, and the improvement of productivity, not the mere digitalisation. It follows that DT, in this scenario, is the recommended path to achieve competitive advantage.

Moreover, the rapid pace of change and the fast evolution of digital solution decrease the technologies' lifecycle and make easier their obsolescence undermining the efficacy of the investments. Therefore, understand the right technology for the business and the right level of digitalisation is a delicate challenge that requires qualified support.

5 Discussion – Supporting and Fostering Digital Transformation and Busienss Model Innovation in Tourism

DT and BMI are essential for organizations competing in this particular business landscape (Berman 2012; Schallmo et al., 2017). These processes favour the enhancement of productivity, performance, as well as the implementation of product, process and business models' innovations that are otherwise impossible to achieve. However, tourism innovation is not an easy process. On the contrary, it entails risks, and it is affected by barriers, difficulties and obstacles mining the exploitation.

From the literature, a lack of knowledge and awareness of the potential of investments in this field has emerged. Besides, costs for change, training and technology implementation proved to be high for most of tourism SMEs. All the more if these costs are linked to the abovementioned lack of awareness.

However, DT is not only about technology (Nonaka and Takeuchi, 2019). The fast development of digital technologies and solutions, raise the efficiency standards, increase the speed of market dynamics, and decrease the product lifecycle (Schiuma, 2012). Moreover, consumers are evolving in prosumers aiming at getting engaged in co-creation processes of products, services, and experiences. Their needs and habits are changing, as well as the ways and speed of exploiting goods. Therefore, innovation rapidly and easily becomes joint and replaced by new emergent innovative solutions. It follows that organizations operating in the digital ecosystem have to become resilient, proactive and able to evolve in the same way the competitive landscape does. Innovation, then, must be recurrent, cyclical. Continuous innovation is required and has to be pursued through a holistic engagement of the whole organization, stakeholders, and customers, rather than just of top management and dedicated facilities. Each actor engaged in innovation must be aware of the organization's vision, goals, and strategies in order to be able to effectively contribute and generate value (Lianto et al., 2018; Nonaka and Takeuchi, 2019).

Moreover, innovation is increasingly digital and data-driven, and frequently organizations have to embark on a digital innovation journey and not without problems.

The fast development of digital technologies contributes to the generation of a high amount of data, information, and knowledge that increase even more the innovation barriers and accelerate the pace of change. To effectively understand and manage technology, codify and exploit generated knowledge, specialized skills and new governance models are required (Joshi et al., 2010). However, even if equipped with high tech infrastructure, and skilled staff, current innovation actors, like R&D labs, or innovation centres, are not able anymore to sustain and enhance the innovation capacity of companies (Capgemini, 2017). These environments are still conceived as separate entities and are not able to guarantee a stakeholders' commitment and a prolific dialogue with the entire organization. Employees, due to a mismatch in terms of digital skills and awareness, are not able to understand the reasons and potential of new technology implementation and shift.

Digital innovation, indeed, is not only about technology innovation. It is more about the innovation of knowledge and cultural attitudes. Therefore, a further challenge in the digital ecosystem is the promotion and definition of conditions, roadmaps and management models for the implementation of digital innovation strategies, to manage digital knowledge and foster continuous innovation (Bharadwaj et al., 2013; Nonaka and Takeuchi, 2019). A mindset, therefore, composed of skills and attitudes necessary for the management of new digital solutions that, in the future, will be even more numerous and frequent, is required. Furthermore, companies used to invest in technologies and processes to generate and develop new digital solutions. For these organizations often concerns do not arise regarding the accompanying of these activities with BMI ones. However, if a new technology were introduced in a new market through two different business model, it leads to completely opposite results. Therefore, it emerges the importance of investments in innovation capacity development in order to manage these technologies and innovate organizations' business models to face context changes and continuously new digital solutions. What is needed is then a digital innovation capacity understood as the attitude to innovate and managing digital innovations.

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Leveraging Public Innovation Labs for the Adoption of AI in Society 5.0

Francesco Santarsiero*

Department of Mathematics, Informatics and Economics
University of Basilicata – Italy
Via dell'Ateneo Lucano, 10 - 85100 Potenza

Giovanni Schiuma

Department of Management, Finance and Technology
LUM University Giuseppe Degennaro
S.S. 100 km 18 - 70010 Casamassima (Bari) – Italy

* *Corresponding author*

Abstract

The paper examines the role of Public Innovation Labs (PILs) in facilitating the adoption of Artificial Intelligence (AI) in Public Administrations (PAs) and promoting the principles of Society 5.0. PILs are viewed as an essential management model that integrates an organizational initiative and management toolbox to support the implementation, adoption, and exploitation of enabling technologies, with a particular focus on AI, to improve sustainable value creation dynamics, social innovation, and the transformation of cities and communities.

Although many organizations have experimented with innovation labs, there is a lack of understanding of their role, governance models, working mechanisms, and adopted tools in the public sector. PILs offer a space for experimentation and collaboration where PAs can gather feedback from citizens to identify and implement solutions that meet their specific needs, facilitating the adoption of AI in PAs.

The paper conducts a case study of a PIL identified as a best practice in supporting PAs in implementing AI-based solutions to improve the urban context and the life quality of communities. The study outlines the management principles of a PIL and provides a roadmap, guidelines, and policy directions to foster the diffusion of PILs among PAs interested in becoming data-driven organizations.

Overall, the research contributes to understanding the critical role of PILs in facilitating the implementation of AI in PAs and fostering the adoption of Society 5.0 principles in the public sector. The study provides insights into the benefits and challenges of implementing AI in PAs and how PILs can support overcoming these challenges and realizing the potential benefits. The paper emphasizes the importance of human-centric and user-driven

approaches and enabling technologies in tailoring the offer of services and products, improving performance, and creating value for people and communities.

Keywords – Public Innovation Labs; Innovation Management; Artificial Intelligence; Society 5.0

Paper type – Academic Research Paper

1 Introduction

In recent years, there has been a growing interest in investigating and identifying management models that follow human-centred and user-driven principles and that exploit enabling technologies to understand the needs of users, people, and communities and accordingly tailor the offer of services and products and improve performance and create value (Santarsiero et al., 2021; Schiuma et al., 2021). This need has become more and more recurrent among Public Administrations (PAs), which often show a reluctance to digital transformation due to a lack of cultural mindset and digital skills, and often incur huge investments to implement transformation processes of cities that, however, turn out to be unsuccessful and do not respond to the real needs of communities (Brunetti et al., 2020; Mittal, 2020). In this perspective, Public Innovation Labs (PILs) can be poised to become a ubiquitous part of the social infrastructure of modern societies. A PIL is configured as an environment of technological experimentation and creative cross-fertilisation that, following human-centric and user-driven approaches, supports organisations in implementing and exploiting enabling technologies facing the real needs of users and communities and fit the application context (Carstensen and Bason, 2012; Lewis and Moultrie, 2005). Despite many organisations experimenting with adopting management initiatives that can be interpreted as innovation labs, the phenomenon is still understudied significantly in the public sector. There is a lack of understanding of their role, working mechanisms, governance models and adopted tools (Memon et al., 2018; Osorio et al., 2019; Schmidt and Brinks, 2017). The paper proposes the PILs as a valuable management model integrating an organisational initiative and a management toolbox to support the implementation, adoption and exploitation of enabling technologies, with a particular focus on the role of Artificial Intelligence (AI) to supporting PAs in improving sustainable value creation dynamics for urban purposes, social innovation and fostering the transformation

of cities and communities according to the principles of society 5.0, based on innovative, human-centric, resilient and sustainable processes. The idea behind PILs is to create a space where PAs can experiment with new technologies and gather feedback from citizens to identify and implement the solutions that best meet their needs. This approach allows PAs to go beyond a one-size-fits-all approach, which can be detrimental for both citizens and PAs, and instead create custom solutions that truly meet the community's specific needs (Wirtz et al., 2019). PILs play a crucial role in facilitating the implementation of AI in PAs by assuming a coordinating role and becoming a tool to support the public sector for urban purposes and social innovation (Shneiderman, 2020). The ability of AI to process large amounts of data and make predictions about future events makes it a powerful tool for PAs, which can be used to improve service delivery, decision making and overall efficiency of the public sector (Bock et al., 2020; Girasa, 2020). However, implementing AI in PAs can be challenging, as it requires a deep understanding of the community's specific needs and the ability to communicate and collaborate with citizens effectively. PILs, by providing a space for experimentation and collaboration, can help bridge this gap and facilitate the implementation of AI in PAs. This paper focuses on exploring the role of PILs in facilitating the adoption of AI in PAs with a specific focus on the role of AI in society 5.0. Society 5.0 is a vision for a future society in which advanced technologies such as AI, big data, and the Internet of Things (IoT) are used to create a more sustainable, resilient and human-centric society. The paper, after a literature review of PILs aimed at understanding their role, working and management mechanisms, will conduct a case study of a PIL identified as a best practice that supports PAs in the implementation of AI-based solutions to foster value creation dynamics, social innovation and to improve the urban context and the life quality of communities. This will make it possible to outline the management principles of a PIL and to define a roadmap, guidelines and policy directions to foster the diffusion of the phenomenon among PAs willing to become data-driven organisations and interested in exploiting technologies to make wiser AI-supported decisions that align with the principles of society 5.0. Furthermore, the case study will provide insight into the benefits and challenges of implementing AI in PAs and how PILs can support overcoming these challenges and realising the potential benefits. Overall, this research will contribute to understanding how PILs can play a crucial role in facilitating the

implementation of AI in PAs and fostering the adoption of society's 5.0 principles in the public sector.

2 Theoretical Background

The widespread adoption of AI has led to the emergence of Society 5.0, a human-centred society that aims to solve social challenges and promote economic growth using AI and other technologies. Society 5.0 focuses on achieving seamless integration between cyberspace and physical space by harnessing AI, big data and the Internet of Things (IoT) to create a more efficient and smarter society. However, the adoption of AI by governments presents a unique set of challenges. Sun and Medaglia (2019) conducted a study on the challenges of implementing AI in the public health sector and identified several key issues, including data quality, lack of technical expertise, privacy concerns and ethical considerations. These challenges are not limited to the healthcare sector and can be observed in different areas of public administration.

The implementation and adoption of AI in the public sector remains limited, despite the potential benefits of AI in public services. The lack of clear policies and regulations, limited technical capacity and limited financial resources hinder the successful implementation of AI in public services, as noted by Misuraca and Van Noordt (2020). Furthermore, the use of AI in the public sector raises several ethical issues, including transparency, fairness and accountability. The use of algorithms in decision-making processes, such as recruitment and public safety, can perpetuate bias and discrimination. Lack of transparency in the development and use of AI models can limit public trust in government decision-making.

The challenges of implementing AI in the public sector require careful consideration and management. Governments must prioritise the development of clear policies and regulations, invest in technical skills and capabilities, and address ethical issues to ensure that the benefits of AI can be fully realised in the public sector.

There are four focus areas in which PAs can engage to play a crucial role in fostering the adoption of AI in Society 5.0. First, there is a need to foster the creation of ecosystems that promote AI innovation, bringing together researchers, policymakers, practitioners and citizens to collaborate on the development of AI-based solutions. Secondly, there is a need to facilitate knowledge sharing among the various stakeholders of Society 5.0 by creating

platforms for the exchange of information and best practices. Thirdly, there is a need to set up test beds for new AI applications and to help create ethical and accountable, transparent and responsible AI systems. Finally, there is a need for approaches that can act as facilitators of public-private partnerships that promote the adoption of AI in Society 5.0, bridging the gap between governments and businesses.

In this context, PILs can play a crucial role in addressing these challenges and taking advantage of these opportunities. PILs are management models that focus on promoting innovation in the public sector. PILs can provide an environment for experimentation and innovation, where new ideas can be tested and refined. They can also provide a platform for collaboration among different stakeholders, including government, industry, and academia.

PILs can help governments develop and implement human-centric AI-based services, ensuring that AI is used to enhance the quality of life for citizens. PILs can also help governments adopt the Government as a Platform approach, by providing a platform for collaboration and knowledge-sharing among different governments. PILs can support governments in making strategic use of public procurement, by facilitating partnerships between governments and industry.

Finally, PILs can play a critical role in safeguarding fundamental rights in AI-based public services and protecting societal infrastructures. Misuraca and Van Noordt (2020) highlight the importance of ensuring trustworthy AI in the public sector, as there are concerns around the potential for AI to perpetuate biases and discrimination, and to violate privacy and other human rights. PILs can act as a testing ground for AI-based public services, allowing for the evaluation of the impact of AI on fundamental rights and societal infrastructures. Additionally, PILs can promote transparency and accountability in AI-based decision-making by ensuring that citizens have access to information about the algorithms used and the data collected.

3 What is Public Innovation Lab?

A Public Innovation Lab (PIL) is a term used to describe a diverse range of organisations that are tasked with promoting innovation and fostering the development of new ideas in the public sector. According to Schuurman and Tõnurist (2017), PILs are "change agents" that operate with a high degree of autonomy and are structurally set apart from the rest of the public sector. PILs are

dedicated "safe" spaces where experiments with policy ideas and innovations can take place (Carstensen and Bason, 2012). PILs are experimental in nature and are ongoing structures that use experimental methods to address social and public challenges (Puttick, 2014). PILs vary significantly in their proximity to executive power, with some centrally located within the executive branches of government, while others sit between multiple government agencies and departments or operate as non-governmental organisations contracted to work on policy and public sector innovation. While the term PIL may be indeterminate and often used interchangeably with other terms, such as government innovation labs or social innovation labs, what distinguishes PILs is their use of novel experimental methods. PILs employ different methodological approaches, including user-centred design, new analytical techniques in data science, randomised assignment experiments, and behavioural insights. Therefore, PILs are "ideational institutions" or "experimental R&D lab[s] for solving the social and public problems that vex governments" (Williamson, 2015). PILs are becoming increasingly popular worldwide, with PILs emerging in different contexts, such as the MindLab in Denmark, the Behavioural Insights Team in the United Kingdom, and the Office of Innovation in the United States, among others.

The PILs' distinguishing characteristics described in the management literature, allow to conceive these peculiar labs as innovation management models based on the construction of an innovative space – physical, virtual, hybrid, relational – on the definition of dedicated time for innovation; and on the development of a platform that contemplates tangible and intangible infrastructure dimensions (Schiuma and Santarsiero, 2023). They can drive the organisation in finding the best ways to generate knowledge and digital culture, in introducing technology, digitising operations and implementing digital strategies for continuous and digital innovation.

The management cycle of PILs can be divided into five critical phases (Santarsiero et al., 2021): focusing, engagement and enabling, developing innovative solutions, delivering and application support, and reviewing and consolidating. The first phase, "focusing," involves defining strategic intentions, developing a shared vision, and identifying necessary resources to develop a project plan. The second phase, "engagement and enabling," focuses on activating facilitation mechanisms to engage users and encourage a working atmosphere that reduces hierarchy, provides stimuli to empathize with given challenges, and stimulates creativity and innovation. Additionally, the innovation

lab may act as an innovation intermediary to build communities and partnerships with various stakeholders, according to users' needs and pursued innovation goals. The third phase, "developing innovative solutions," begins once the challenges and objectives have been addressed. During this phase, traditional innovation management stages are followed to transform ideas into solutions or to develop innovative skills and mindset in users. Innovation labs should provide services such as mentoring, coaching, or facilitating sessions with final users to gain feedback and control the risk of failure. Tools, equipment, and technologies for testing and prototyping should be made available under assistance. After the innovation development, the fourth phase, "delivering and application support," is aimed at delivering and/or applying the generated value. In this phase, innovation labs provide consulting or mentoring services, assisting users in activities such as developing time-to-market, go-to-market, or growth hacking strategies, codifying learned knowledge, or improving routines. Additionally, innovation labs may play a strategic role in building bridges between companies and markets. The final phase, "reviewing and consolidating," involves reviewing activities carried out and reflecting on final results. Insights are detected from comparing final results with initial objectives, from which new innovation activities and strategies can be designed and learned.

4 Public Innovation Lab for the adoption of AI in Society 5.0 – Insights from a case study

4.1 Methodology

This study uses a case study analysis approach to examine the Smart Government Innovation Lab (SGIL) in Hong Kong as an example of a Public Innovation Lab (PIL) for Artificial Intelligence (AI) adoption in the public sector (Yin, 2009). The case study methodology allows for an in-depth exploration of the SGIL's role in promoting AI adoption in the public sector, as well as its effectiveness in achieving the goals of Society 5.0.

Data collection methods included secondary data sources such as website materials, government reports, and media coverage (Myers, 2013). The selection of the SGIL as a case study was based on its prominence as a PIL for innovation in the public sector, as well as its focus on AI and related technologies. The SGIL was established in 2016 by the Hong Kong Special Administrative Region Government

with the aim of promoting innovation in the public sector and developing new technologies for public service delivery.

The analysis approach involved an examination of the SGIL's organizational structure, its functions and activities, and its impact on AI adoption in the public sector. The effectiveness of the SGIL's approach was evaluated by considering its alignment with the recommendations from the European Union's AI Watch report, including the provision of human-centric AI-based services, the government as a platform approach, the strategic use of public procurement, and the safeguarding of fundamental rights in AI-based public services.

The Smart Government Innovation Lab in Hong Kong provides a valuable case study for the examination of the potential of Public Innovation Labs for AI adoption in the public sector. However, the case study is limited by the availability of secondary data sources and may not provide a comprehensive picture of the SGIL's activities and impact. Future research could benefit from incorporating primary data collection methods such as semi-structured interviews with stakeholders involved in the SGIL's activities.

4.2 Research Context

The Smart Government Innovation Lab HK (SGIL) was selected as the case study for this research. SGIL was established in 2016 by the Government of the Hong Kong Special Administrative Region (HKSAR) with the aim of providing a collaborative platform for government departments to test and develop innovative digital solutions. SGIL operates under the Office of the Government Chief Information Officer (OGCIO) and is supervised by a steering committee comprising senior officials from various government departments.

SGIL's activities are guided by its mission to enhance public services through innovation and technology, and to promote the development of a smart city in Hong Kong. The lab focuses on four main areas: artificial intelligence, smart mobility, digital government, and Internet of Things (IoT). SGIL aims to promote the adoption of innovative technologies by facilitating collaboration between government departments and industry partners.

SGIL has initiated several projects that leverage AI technologies to improve public services in Hong Kong. One such project is the Chatbot Framework, which was developed in collaboration with Microsoft Hong Kong. The framework enables government departments to easily create and deploy chatbots to

enhance their service delivery. Chatbots have been deployed in various departments, such as the Immigration Department and the Customs and Excise Department, to provide round-the-clock assistance to the public.

Another project is the Smart Traffic Management System, which utilizes AI to improve traffic flow and reduce congestion in the city. The system is able to predict traffic volume and adjust traffic signals accordingly, thereby reducing waiting times and improving the overall efficiency of the road network.

SGIL has also developed the Anti-Mosquito Robot, an AI-powered robot that can detect and eliminate mosquito breeding sites in public areas. The robot has been deployed in various locations across Hong Kong, including parks and housing estates, to help combat mosquito-borne diseases.

4.3 Research Results

The Smart Government Innovation Lab (SGIL) is structured around the five phases of the Public Innovation Labs (PIL) management model. In the first phase, the focus phase, the SGIL identifies priority areas for innovation and challenges to be addressed through collaboration with public sector stakeholders such as government departments, non-governmental organisations and universities.

In the second phase, the engagement and enablement phase, the SGIL encourages collaboration among stakeholders and provides support to enable innovation by organising events such as workshops and seminars, and providing a platform to share ideas and experiences.

In the third phase, the development phase, the SGIL supports the development of innovative solutions by providing resources such as funding, expertise and access to data. The lab also works with stakeholders to design and test prototype solutions, ensuring that they meet the needs of end users.

In the fourth phase, the delivery and application support phase, SGIL helps to implement and scale the solutions developed in the lab. This involves working with stakeholders to ensure that the solutions are integrated into existing systems and processes, and providing ongoing support to ensure that they work properly.

In the fifth and final phase, the review and consolidation phase, the SGIL assesses the impact of the solutions and identifies opportunities for further improvements. This involves collecting feedback from stakeholders and conducting reviews to assess the effectiveness of the solutions in solving the identified challenges.

The SGIL team consists of experts from various fields, including information technology, engineering, and business management, who work together to develop innovative solutions to public sector challenges. The lab also partners with academic institutions and private companies to access the latest technologies and expertise. This collaborative approach enables SGIL to access a wide range of knowledge and resources to develop effective solutions.

The adoption of AI in public services has resulted in several benefits for the government and citizens. For example, the AI Chatbot Service has reduced the need for human customer support, resulting in cost savings and faster response times. The STMS has improved traffic management, resulting in reduced congestion and improved safety on the roads. The use of AI in public services has also created value for citizens by providing more convenient and accessible services.

Moreover, the use of AI has enabled government departments to reduce costs and increase efficiency in their service delivery. Chatbots, for instance, have enabled departments to handle a larger volume of inquiries without the need for additional staff. The adoption of AI has also enabled the government to provide more personalized and effective services to the public. Chatbots are able to provide customized responses to user inquiries, based on their specific needs and preferences. Lastly, the adoption of AI has created value for society by improving public health, reducing traffic congestion, and promoting the development of a smart city.

In conclusion, the Smart Government Innovation Lab in Hong Kong has successfully demonstrated the potential of public innovation labs in promoting the adoption of AI in government operations. By adopting a human-centric approach and partnering with academic institutions and private companies, SGIL has successfully developed innovative solutions to public sector challenges. The adoption of AI in public services has resulted in several benefits, including cost savings, increased efficiency, and improved service quality. However, the use of AI in public services also poses challenges, such as the need to ensure transparency, accountability, and fairness in decision-making. Therefore, it is essential to continue evaluating and improving the use of AI in public services to ensure that it is used responsibly and effectively for the benefit of society.

4 Conclusions

The adoption of AI in Society 5.0 requires a solid innovation strategy, and PILs have emerged as a promising approach to achieving this goal. PILs have the potential to foster innovation in the public sector, and their collaborative spaces provide an opportunity for public, private, and community stakeholders to co-create innovative solutions to societal problems. By leveraging the framework presented in this paper, PILs can effectively support the adoption of AI in Society 5.0 by implementing key strategies and best practices for successful implementation.

The case study of the Smart Government Innovation Lab in Hong Kong has demonstrated the benefits of using PILs in promoting innovation in the public sector through AI. The lab has successfully adopted AI to enhance the efficiency and effectiveness of public services, creating value for the society. However, the limitations of the case study should be noted, and further research is needed to explore the potential of PILs in different contexts.

The implications of our findings suggest that PILs can be a valuable tool for promoting the adoption of AI in Society 5.0. PILs provide a collaborative space that encourages experimentation and learning, and their evidence-based insights can inform policy-making processes.

This research suggests several areas for future research in this field. Firstly, it is necessary to further explore the role of PILs in promoting the adoption of AI in the public sector, and to investigate how PILs can effectively manage the adoption process. Secondly, it is important to examine the ethical and social implications of AI adoption in the public sector, and to develop policies and frameworks that ensure the responsible and equitable use of AI. Finally, it is necessary to explore the potential of AI in promoting citizen participation and engagement in the public sector decision-making process.

The results of this research can be used to inform and develop policies and programs aimed at promoting AI adoption in the public sector. In particular, the effective management practices of Smart LAB can serve as a model for other PILs looking to adopt AI in their operations. Additionally, the successful projects developed by Smart LAB can be used to demonstrate the value of AI adoption in the public sector to policymakers and the public. Ultimately, the adoption of AI in the public sector has the potential to transform the way governments operate, and to create more effective and efficient public services that better serve citizens.

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For Wider Sustainability

Enrico Sicignano

Department of Civil Engineering
University of Salerno
Via Giovanni Paolo II, 132 - 84084 Fisciano (SA)

Abstract

The European Agenda for Sustainable Development has set a target of 2030 to achieve 17 Sustainable Development Goals (SDGs) which are: 1: Eradicate poverty; 2: Eradicate hunger; 3: Health and wellbeing; 4: Quality education; 5: Gender equality; 6: Clean water and sanitation; 7: Clean and affordable energy; 8: Decent work and economic growth; 9: Business, innovation and infrastructure; 10: Reducing inequalities;11: Sustainable cities and communities;12: Responsible consumption and production;13: Combating climate change;14: Life under water;15: Life on Earth;16: Peace, justice and sound institutions;17: Partnership for the goals (1/2 - 2/2) and 169 associated sub-goals . This contribution makes a reflection aimed at extending the concept and meaning of sustainability, to speak and bring into play - clearly and explicitly - other mental categories and values such as the human dimension of domestic and urban space, mathematical perfection, roots and historical memory as well as aesthetic quality. Citing some of Italo Calvino's The Invisible Cities therefore seemed appropriate and pertinent. To emphasise the importance of the role of memory and roots, reference is made to classical mythology to examine two emblematic figures: Ulysses and Aeneas.

Keywords – Sustainability, Memory, Roots, Aesthetics

Paper type – Academic Research Paper

1 Introduction

The 17 Sustainable Development Goals or Goals of the European Union to 2030 are a necessary but not sufficient condition. This contribution makes a reflection on extending the concept and meaning of sustainability to talk about and bring into play – clearly and explicitly – other mental categories and values such as the human dimension in both domestic and urban spaces, mathematical perfection, roots and historical memory, as well as the aesthetic quality that can be glimpsed again in some recent interventions both at a national and international level. It is

complexity that governs today's building process in all its phases, from the initial design to execution, testing, management and maintenance. The approach can only be multidisciplinary and transversal. The problems of architecture must be solved in a broader scenario that is no longer only strictly disciplinary.

2 Sustainability

From a political, social and economic point of view in the supranational dimension of the Member States, the European Agenda for Sustainable Development has set the achievement of 17 Sustainable Development Goals (SDGs) to 2030, which, as is well known, are: 1: Overcoming poverty; 2: Overcoming hunger; 3: Health and wellbeing; 4: Quality education; 5: Gender equality; 6: Clean water and sanitation; 7: Clean and accessible energy; 8: Decent work and economic growth; 9: Business, innovation and infrastructure; 10: Reducing inequalities;11: Sustainable cities and communities;12: Responsible consumption and production;13: Combating climate change;14: Life under water;15: Life on Earth;16: Peace, justice and sound institutions;17: Partnership for the Goals (1/2 - 2/2) and 169 associated sub-goals that take into account different dimensions in a balanced manner. Each objective is then broken down into state of the art, programme implementation methods, actors involved, time and costs, expected results and objectives achieved, and verification and feedback. In particular, "Point 11 Sustainable Cities and Communities", the one that concerns us most closely, is divided into 10 Goals. Development is Sustainable when it is the intersection of four areas of sustainability: economic, social, environmental and institutional. This is a necessary but not sufficient condition.

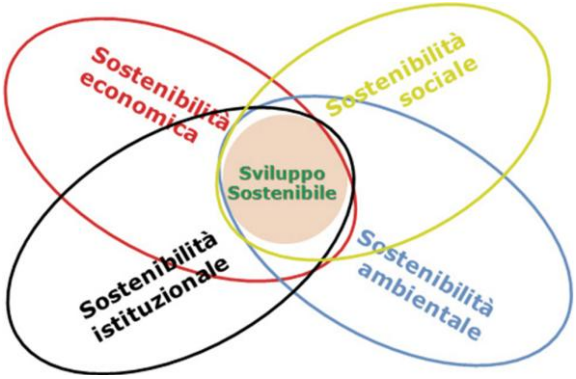

Fig. 1 - Sustainable Development

To be sufficient, at least three other values (but there are others) must come into play: aesthetic quality, the human dimension, roots and memory. Aesthetic quality is in turn attainable through two paths: beauty and exactitude, mathematical perfection. We also know that at very high levels, the two categories, the artistic and the scientific, touch each other, equate, sometimes they can be the same thing. Artifice and nature have always been two realities that are only apparently distant and separate, but in reality, they are inseparable; with artifice, art has always followed nature by imitating its laws, but also building its own autonomy. Thus, man's works are defined as works of art and works of genius if they have an aesthetic quality of beauty and mathematical perfection, even if achieved with special techniques.

3 Mathematical perfection

The golden number, identified by the Greek letter φ (phe) and whose approximate value is 1.6180, is first mentioned by Euclid (4th-3rd century B.C.) in Book VI of the Elements. The golden number is found throughout the architecture of Greek temples, in the works of Leon Battista Alberti, Luca Pacioli (1509 De Divina Proportione), Piero della Francesca, Leonardo, and Albrecht Durer. The golden number is associated with the Fibonacci Series. The Golden Ratio and the Golden Number are held in high regard by Wolfgang Amadeus Mozart, just as it is present in the helical structure of DNA. For example, the nautilus is the natural manifestation of the golden spiral that underlies the architectural composition, both in plan and elevation, of the Parthenon, the most perfect building of all time. Similarly, Giuseppe Terragni re-proposes the golden spiral in the architectural version of the Divine Comedy, the Danteum, a work only designed. In the representation of Inferno, the circles follow one another according to the golden spiral, descending in landings that each have a column in the centre.

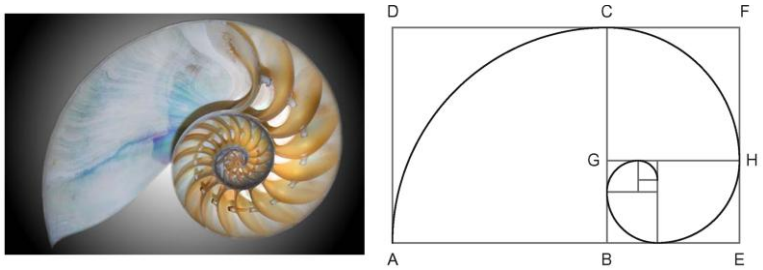

Fig. 2 – The Nautilus and the golden spiral



Fig. 3 – The Parthenon (447-432 BC)

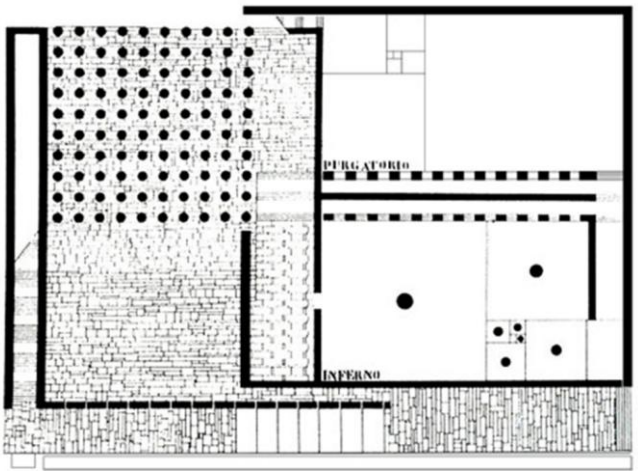

Fig. 4 – Danteum by Giuseppe Terragni (1938)

The geometric construction is present in the work of Leon Battista Alberti who speaks of concinnitas which means refinement, elegance and, in the Renaissance, harmony. In the Malatesta Temple in Rimini, Leon Battista Alberti secretly and never mentioning the type of proportion uses the golden section as a recurring and permanent rule that dominates all his works and constructions. The classical inheritance lives again, in a changed guise and masterfully metabolised, in the thought and work of Le Corbusier, who sinks and founds all his poetics by excavating into the Hellenic world in search of an order and harmony that is always implied, subtended but present in all his works, both in architecture and painting, which can be found in the regulating traces of his Purist works. The Ville Savoye, the Maison a Garches, the Maison La Roche and the Villa Stein above all

are the physical, three-dimensional explication and embodiment of composition according to proportions, harmonic squares and rectangles and according to the golden section.

4 The human dimension

The other value is the human dimension of the space as it once was in the ancient Greek polis, both in the domestic space and in the urban space, in the public works, the agora, the temple, the acropolis, the theatre all interconnected and related to each other. To cite just one example, the space of the Forum of Pompeii with the Temple of Jupiter, the Basilica, the building of Eumachia has a human dimension, which the young Le Corbusier measures with his own steps and sketches to treasure his knowledge of the classical world and thus his own poetics. The domestic space of the House of the Vettii, elegant and stately is the same. Beyond the Greek and Roman worlds, even the medieval city, especially the Italian one, always follows the morphology of places, its narrow streets, alleys, glimpses, and its square with its church is on a human scale. The Italian piazza is the living room of the town and the city, where everyone loves to gather, to meet and there to have those 'non-economic' moments (as the French sociologist Emile Durkheim would say) that are so useful to the life of a person and a society. This is true not only for St Mark's Square in Venice, Piazza del Campo in Siena, Piazza Navona or St Peter's in Rome, but also and above all for all the anonymous squares in thousands of towns, villages, historic centres and minor fabrics that are the 'crystallised memory' of those places.

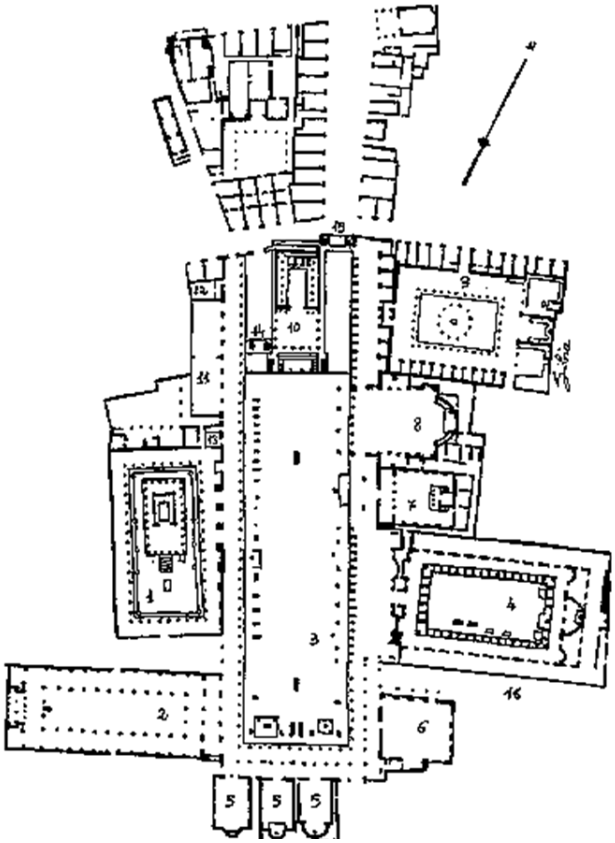

Fig. 5 - Forum of Pompeii

5 Roots and memory

Urban space on a human scale was perpetuated in towns and villages for centuries throughout the Middle Ages, the age of the Communes, and the Renaissance. The Italian situation is then unique. Historical memory is enriched with new values, grows, modifies itself without ever forgetting the root. The Roman amphitheatre of Lucca is the maximum in this sense, with the settlements and stratifications that have taken place over the centuries but respecting the Roman layout of the amphitheatre, its geometry in plan, its ellipsoid shape. For climatic reasons (we have no deserts, no unexplored Amazonian forests, etc.) the Italian situation also witnesses the anthropisation of the landscape. While the city designed on the drawing board is not a city born and developed spontaneously; it is dropped from above with precise forms where axes and paths predominate. This is the case of Palmanova, but also of the utopian cities of Owen and Fourier,

the city of Chaux or Brasilia, the new capital of Brazil by Lucio Costa, Oscar Niemeyer, Rino Levi, Roberto Burle Marx, where everything is designed in a monumental manner and on a large urban scale.



Fig. 6 - The town of Palmanova (1593)

Chandigarh, the capital of the Indian state of Punjab, is no less impressive with important works and institutional sites such as the Parliament, the Capitol, the seat of the High Court of Justice, the Secretariat, the Art School, the Nautical Club, all designed by Le Corbusier. Large spaces and different road networks, public, private, squares, water tanks characterise the complex, but where what is missing is precisely and above all the human dimension. A built utopia and mega-structure is The Unitè d'Habitation in Marseille designed by the same Swiss-French Master, conceived as a small self-sufficient city, suspended on pilotis, with all services, a kindergarten on the roof, etc. Nowadays, it is fashionable and chic to live there but as soon as it was finished it remained empty for three years because nobody wanted to go and live there.



Fig. 7 - The Unitè d'Habitation in Marseille by Le Corbusier (1952)

It has the same number of inhabitants as a medieval village. In some contemporary cities and metropolises, the memory has been completely erased because the infrastructure, the motorway networks, have taken over and obeyed only the iron laws of efficiency and safety. In The Invisible Cities, Italo Calvino, with regard to the relationship between the city and desires, describes Zenobia as follows:" Having said this, it is pointless to establish whether Zenobia is to be classified among the happy cities or among the unhappy ones. It is not into these two species that it makes sense to divide the city, but into two others: those that continue, through the years and mutations, to give their shape to desires and those in which desires either succeed in erasing the city or are erased from it'. Having lost the relationship with memory, or the relationship it never had with memory, the contemporary city has become a city of fear due to the coexistence of millions of people, the loss of quality of life and deteriorating relationships, social conflict, unease, marginalisation. Crime and violence proliferate. This explains Stanley Kubrick's 1971 film 'A Clockwork Orange', the sad and painful outcome of a sick society that has lost values. Anthropological and social degeneration also takes shape in the degraded urban suburbs where, in some of them, memory, urban and architectural aesthetic quality, and the dignity of people and places have never existed. Among the many places that can be mentioned, certainly and by way of example, it is worth mentioning the Vele of Scampia in Naples, a degraded suburb where the failure of the utopia of Naples, of its alleys and social solidarity was consummated, transformed, abandoned to

itself and to its fate, into a hallucinating and gruesome nightmare masterfully witnessed by the film Gomorra. Cities can also be impossible or unlivable. Diego Lama has ironically drawn 'Città di china', a set of extraordinary sketches of how the city should not be (windy city, city of the splitter, city with archaeological constraints, etc.) exasperating the negative and worst sides of a city and its citizens. It is our duty as educators, teachers, critics, and professionals to say yes to energy efficiency, renewable sources, NZEB, and near-zero consumption buildings, but what should never be lacking, in a discourse of broader sustainability, is the quality of architecture, in which the words and concepts of aesthetics, mathematical perfection, exactitude, beauty, roots, memory, and creativity converge. The new law of the Campania Region, no. 19/2019, for the first time incentivises and advocates the quality of architecture in public and private works to once again affirm the centrality of the project in the processes of recovery, reuse, redevelopment, restoration and new one. Quality can again be glimpsed in a number of recent interventions both nationally and internationally where it is now complexity that governs the building process in all its phases, from initial design to execution, testing, management and maintenance. Moreover, the approach cannot but be multidisciplinary and transversal to several fields, as in the intriguing and beautiful recent project of the 'Bosco Verticale' in Milan by Stefano Boeri, where energy, technical physics, and botany issues are well combined with architecture, structural engineering, and technological systems, also achieving an objective new aesthetic quality in building and urban design.



Fig. 8 – Bosco vertical by Stefano Boeri (2009-2014)

The project must be universal, designed for everyone and for a multi-ethnic society, open, dynamic, in progress. The problems of architecture must be solved in a broader scenario that is not only strictly disciplinary. The architectural project must strive to satisfy all the 17 Goals/Goals of Sustainable Development of the 2030 Agenda, without ever forgetting beauty, aesthetic qualities, roots, memory, the human dimension of which the historic Italian city remains an absolute model for all that it has contained among its stones for centuries. Once again Italo Calvino returns when he describes Zaira in 'The Invisible Cities': "Of this wave flowing back from memories, the city soaks up like a sponge and expands. A description of Zaira as it is today should contain all of Zaira's past. But the city does not say its past, it contains it like the lines of a hand, written in the corners of the streets, in the grills of the windows, in the handrails of the stairways, in the antennas of the lightning conductors, in the poles of the flags, each segment striped in turn with scratches, serrations, notches, twists."

6 Conclusions

The black box of ancient Mediterranean civilisations and Western thought is mythology and myth telling. In it, I have always identified two existential archetypes, two protagonists, two behavioural models that we can thus relate to the above reflections. On the one hand, Ulysses who travels the sea for ten years; he fights against bullies; he overcomes all kinds of pitfalls; he resists the song of the Sirens; he falls in love with the beautiful and seductive Calypso; he witnesses the transformation of his companions into pigs by the Sorceress Circe; he blinds Polyphemus. The Odyssey is man's journey within himself and is not completed until these complex human experiences are concluded. Outside of myth and in normal, 'human' discourse, the relevant geographical distances could have been bridged in quite different times. This is not the case. In the myth, however, the journey lasts ten, long years. The return to his Ithaca is difficult and complex: the recognition only by the faithful dog Argos, the arcane question to Penelope linked to a marital secret to prove to her that it is indeed him, although tired and aged, the revenge and the killing one by one of the Proci who, taking advantage of his absence, took possession of his house, devastated and violated it; they undermined his wife Penelope, etc., In Homer, all this story begins and ends with him. It is only Dante who in the Divine Comedy (26th Canto of the Inferno) where sets Dante on a journey as far as the Pillars of Hercules (the present Strait of

Gibraltar), eager to go into the world of the unknown, and who reminds his sceptical and reluctant companions, calling them to follow him again "Consider your seed: you were not made to live like brutes but to follow virtue and knowledge". The Homeric Ulysses ends his journey and his life in Ithaca. And everything ends with him. On the other hand, we have another existential and behavioural archetype from classical mythology: Aeneas and we go straight to an extraordinary representation of him. In the sculptural group, a masterpiece by Gian Lorenzo Bernini, preserved in the Galleria Borghese in Rome; he carries his elderly father Anchises on his shoulders, who in turn holds the urn with the ashes of his ancestors (the Penates) and his young son Ascanius. He is fleeing from the flames, destruction and death of Troy in a complex and dangerous journey that leads him to the end and ends with the foundation of Rome as he is foretold by the Cumaean Sibyl in the cavern of the Sibyl at Cumae. This sculptural group simultaneously represents the past, the present and the future. It is the root that perpetuates itself and goes forward. It is a warning. And it is exactly what we should all do and never forget.

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Knowledge Hiding in Organizations: Systematic Literature Review

Talshyn Tokyzhanova*

Tallinn University of Technology
Akadeemia tee 3, 12611 Tallinn, Estonia

Susanne Durst

Reykjavik University
Tallinn University of Technology
Menntavegur 1, 101 Reykjavik, Iceland

* *Corresponding author*

Abstract

Although companies frequently make great efforts to encourage workers to share knowledge and voice concerns, many workers intentionally choose to conceal their knowledge rather than share it. This 'an intentional attempt by an individual to withhold or conceal knowledge that another person has requested" is called knowledge hiding.
This review systematically reviews, categorises, and synthesises the current body of literature regarding knowledge hiding. The current literature is categorised based on methods, theories, research context, and geographical distribution. Secondly, the antecedents and outcomes of a KH across the different levels of analysis are mapped using an inductive approach. This thematic map offers a visual guide to KH, placing antecedents and outcomes at different levels of analysis and suggesting where future research in KH might be headed.

Keywords – knowledge hiding, knowledge withholding, literature review

Paper type – Academic Research Paper

1 Introduction

Knowledge is a core resource for organisations to gain and keep a competitive advantage (Barney, 1991; Grant, 1996). Studies in the past demonstrated that businesses with effective knowledge management could grow more quickly and are more competitive than others (Wang and Noe, 2010). Therefore,

organisations must encourage employees to share knowledge to get the best performance from their knowledge resources.

Although companies frequently make great efforts to encourage workers to share knowledge and voice concerns, many workers intentionally choose to hide their knowledge rather than share it (Prouska and Kapsali, 2021). In a survey conducted in the USA, 76% of participants acknowledged they had at one point hidden knowledge (Connelly et al., 2012). In a survey from China, 46% of participants said they had hidden knowledge that another person had requested in professional settings (Peng 2013). This 'an intentional attempt by an individual to withhold or conceal knowledge that has been requested by another person" (Connelly et al., 2012, p. 65) is called knowledge hiding (hereafter: KH).

Due to the significance of the subject, there has been a sudden increase of articles on KH in recent years (e.g. Khan et al., 2021; Zhang et al., 2021; Batistič and Poell, 2022; Hao et al., 2022; Guo et al., 2022; Donate et al., 2022; Sofyan et al., 2022). Recent empirical studies confirmed the negative effects of knowledge hiding on individual and organisational outcomes. For instance, diminished creativity (Feng et al., 2022; Chatterjee et al., 2022; El-Kassar et al., 2022), project and task performance (Zhang et al., 2022; Moin et al., 2022; Singh, 2019), innovative behaviour (Chen et al., 2022; Donate et al., 2019) and interpersonal deviance (Arain et al., 2022; Singh, 2019) are some of the problems caused by KH. KH may also have positive intentions or outcomes to protect the other party's feelings, maintain confidentiality, or advance the interests of a third party (Connelly et al., 2012). Existing studies have also begun to investigate situational and interpersonal antecedents of knowledge hiding, such as leader-member exchange (He et al., 2020; Zhao et al., 2019), moral disengagement (Khan et al., 2021), abusive supervision (Hao et al., 2022; Agarwal et al., 2022; Offergelt and Venz 2022; Wang et al., 2021), personality (Soral et al., 2022; Han et al., 2021) and job security (Nguyen et al., 2022; Shoss et al., 2022; Chhabra and Pandey, 2022).

We acknowledge three previous systematic literature reviews have been conducted (Siachou et al., 2021; Anand et al., 2021; Di Vaio et al., 2021). Although these systematic reviews examined KH, substantial research has accumulated in the last two years. At least 200 peer-reviewed articles have been published in only the business and management areas since the last reviews on this topic. This review is different from the review of Siachou et al. (2021) in its search scope: we used WebofScience and Scopus as databases instead of EBSCO and Science Direct; we have included other journals with 2 stars according to the Association

of Business Schools' Academic Journal Quality Guide 2021 and included additional search terms such as "knowledge detention" and "knowledge concealment" instead of general keywords “employee competitive behaviour” or ‘counterproductive work behaviour”. This work is also distinct from the review of Anand et al. (2021) with its inclusion of an additional database, WebofScience. This study is different from Di Vaio et al. (2021) review primarily because we extended search terms from knowledge hiding to knowledge hoarding, knowledge withholding, knowledge detention and other related terms. We have only considered articles exclusively focusing on KH instead of a general focus on knowledge sharing and knowledge management systems. Even though all these three previous systematic reviews have identified antecedents and outcomes of KH, no systematic review has offered a thematic analysis of KH antecedents and outcomes. The current review also includes additional analysis of context (the research setting), data analysis technique, and thematic evolution of KH research that other authors haven’t offered.

Against this background, the aims of our review are threefold. First, we will categorise the current literature based on methods, theories, research context and geographical distribution. Secondly, we aim to map and evaluate antecedents and outcomes of a KH across the different levels of analysis using an inductive approach. Finally, we want to support and advance the theory development of KH. To this end, we systematically reviewed and categorised papers focusing on antecedents and outcomes of KH published between 2012 and 2022 in databases selected according to clearly specified criteria. Thus, our study offers a thematic map that provides a visual guide to KH, placing antecedents and outcomes at different levels of analysis. Based on these aims, we try to answer these research questions:

(RQ1) What methods have been applied in the research?

(RQ2) What theories have been used in the research?

(RQ3) What are the antecedents and outcomes of KH at different levels of analysis?

We begin this article by defining knowledge hiding and distinguishing it from other constructs such as knowledge hoarding, knowledge withholding and knowledge sharing. Then we summarise the method used in selecting and reviewing the literature and detail our search strategy, analysis, and evaluation of the studies reviewed. Following that, we present our findings of the SLR of the papers reviewed. After this, we discuss future directions for theory development,

methodology and content areas. We conclude by considering the limitations of our review and highlighting the paper's contributions to future research on KH.

2 Methodology

Following our study purpose, we adopt a systematic literature review method. In order to gather relevant papers for a particular topic and to avoid bias, this systematic review follows a set of predetermined procedures as outlined by Tranfield, Denyer, and Smart (2003) and Kraus, Breier, and Dasí-Rodríguez (2020). This ensures that the review is reliable, comprehensive, and rigorous (Rousseau, Manning and Denyer, 2008). The procedure consisted of three steps: (1) planning the review, (2) carrying out the review, and (3) reporting the review.

2.1 Planning the Review

The study's criteria for selection were outlined in a protocol for the literature review. Scopus of Elsevier was used to build a database with relevant articles about KH in business and management studies. Compared to WoS, Scopus presently has more extensive coverage of the academic literature. The most recent Scopus fact sheet[1] from 2022 indicates that the database currently includes more than 25,800 active peer-reviewed journals, over 84 million records, and 1.8 billion cited references (dating back to 1970) in different fields. A thorough overview of the Scopus database may be found in a recent paper by Thelwall and Sud (2022).

Next, the authors found 634 articles from the Scopus database based on the abstract, title, and keywords. In the second step, the authors narrowed the results to only the business and management research areas. It yielded 369 papers published in Scopus databases. In step three, the authors only included articles published in scholarly journals to focus on reviewed research. As a result, 341 publications were identified in Scopus. In step four, articles published in languages other than English have been removed, leaving 339 papers. In step five, only articles published in peer-reviewed journals and graded 2, 3, and 4 stars in the Association of Business Schools' Academic Journal Quality Guide 2021 were selected for further examination. Thus, the dataset was reduced to 202 articles. In step six, the authors screened the titles, keywords, and abstracts of all remaining

[1] https://www.elsevier.com/__data/assets/pdf_file/0017/114533/Scopus-fact-sheet-2022_WEB.pdf

papers and excluded those that did not deal with KH or related terms despite prior filtering. As a result, after the screening process, the sample consists of 189 articles from 47 different journals. Table 1 displays the search and selection processes performed in December 2022.

Table 1. Search and selection

Steps	**Scopus**	**Web of Science**
Step 1. Identify relevant studies	n=643	n=476
Step 2. Include the articles in the subject areas Business and Management	n=373	n=284
Step 3. Include the studies that were articles or reviews or early access	n=345	n=271
Step 4. Include the articles in the English language	n=343	n=271
Step 5. Include the articles published in ABS journals ranked 2 or higher	n=204	n=175
Step 6. Remove duplicates	n=209	
Step 7. Exclude the studies based on titles, keywords, and abstracts	n=189	

2.2. Conducting the Review

More thorough explanations of the methods used to locate relevant articles are provided in this section. The search string consisted of the keyword “knowledge hiding”. We also searched for other articles where keywords such as “knowledge withholding”, “knowledge hoarding”, or "counterproductive knowledge behaviour" were used, as we wanted our initial sample to be as complete as possible. Despite using different terms, these articles might be about KH. The complete list of the keywords is adopted from previous systematic reviews by Anand et al. (2021) and Siachou *et al.* (2021).

Table 2. Search syntax in KH

Search terms
TITLE-ABS-KEY ("Knowledge Hiding" OR "Hiding Knowledge" OR "Knowledge Hoarding" OR "Knowledge Withholding" OR "Knowledge Detention" OR "Knowledge Concealment" OR "Non-sharing Knowledge" OR "Knowledge Sharing Barrier" OR "Knowledge Sharing Resistance" OR "Knowledge Sharing Disengagement" OR "Knowledge Sharing Obstruction" OR "Knowledge Sharing Hostility" OR "Knowledge Sharing Blockage" OR "counterproductive knowledge behav"*

Table 3 provides a descriptive summary of the articles included in the present study. The articles involved were produced by 431 authors of which 55 articles were published by a single author, and 140 articles were published as part of a co-authorship.

Table 3. Summary of articles resulting from the searches.

Description	**Results**
Documents	189
Sources (journals)	47
Author's keywords	933
Period	2002–2022
Average citations per document	44.5
Authors	649
Authors of single-authored documents	16
Authors of multi-authored documents	633
Authors per document	3.43

2.3 Methods

First, a descriptive analysis of the database was performed to answer the research questions. In this analysis, each paper was categorised according to its year of publication, authors, journal (ABS ranking is 2 or higher than 2), number of citations, and country of origin, which was determined to be the country of the first author's place of employment. Next, we examined the selected papers to determine the main themes.

3 Results

This section shows (1) the chronological progression of the number of articles published as well as the number of citations and an overview of top-cited articles; (2) publication outlets, and (3) research methods.

3.1 Analysis of findings by the number of articles.

Figure 1 shows the number of articles published and the number of citations by year. The average year of publication is 2020. There is a growing trend in terms of the volume of publications. Only in the last decade has there been an increase in interest in the area of KH in business and management studies. Since 2012, the topic has gained more attention and 85% (160 out of 189) of all articles studied in the current work were published within the last four years.

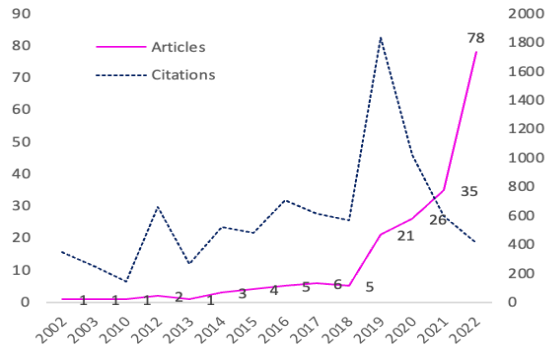

Figure 1. The number of articles published and the number of citations of published papers by year.

The publications included in this study received an average of 44.5 citations out of a total of 8405. Looking more closely, it can be observed that 18 articles (10%) had no citations, 46 articles (24%) had one to five citations, and 54 articles (29%) have been cited 50 or more.

Table 4 demonstrates the top 10 publications with the highest number of citations. 8 articles were published after 2012.

Table 4. Top publications in the KH in business and management studies

Article	Number of citations (WoS Core, if it's not available, then Scopus)
Connelly C.E., **Zweig D**., Webster J., Trougakos J.P. (2012)	596
Černe M., Nerstad C.G.L., **Dysvik A., Škerlavaj M. (**2014)	414
Husted K., Michailova S. (2002)	345
Peng H. (2013)	265
Connelly C.E., **Zweig D.** (2015)	255
Michailova S., Husted K. (2003)	249
Serenko A., Bontis N. (2016)	246
Zhao H., Qingxia, He P., Sheard G., Wan P. (2016)	185
Cerne, M; Hernaus, T; **Dysvik, A; Skerlavaj, M** (2017)	179
Singh S.K. (2019)	163

The authors also organised the retrieved articles based on the first author's country (Table 5). As we can see, most of the articles are produced in China (63 articles), and authors from India (14 articles), Canada (14 articles) and Pakistan (13 articles) are the next most active researchers in the field.

Table 5. List of countries with the largest number of articles.

Country	**No. articles**	**% of articles**
China	63	33,33%
India	14	7,41%
Canada	14	7,41%
Pakistan	13	6,88%
United Arab Emirates	7	3,70%
Australia	7	3,70%
USA	6	3,17%
France	6	3,17%
United Kingdom	4	2,12%
Turkey	4	2,12%

3.2 Publication outlets

As shown in Table 6, most of the articles were published in the Journal of Knowledge Management, accounting for 33% of the studies reviewed (see Table 5). Publications on KH in business and management appear to concentrate in a relatively small number of outlets, with the 3 journals comprising the number of articles making up over 53% of our sample.

Table 6. Journals with the largest number of articles related to studies of KH in the business and management area.

Journals	No. of papers	%	ABS ranking
Journal of Knowledge Management	62	32,80%	2
Journal of Business Research	30	15,87%	3
Journal of Organizational Behavior	9	4,76%	4
Management Decision	7	3,70%	2
European Journal of Work and Organizational Psychology	6	3,17%	3
Journal of Business Ethics	6	3,17%	3
International Journal of Contemporary Hospitality Management	5	2,65%	3
Journal of Managerial Psychology	4	2,12%	3
International Journal of Conflict Management	4	2,12%	2
International Journal of Hospitality Management	4	2,12%	3

3.3 Research methods used in the studies.

Most (93%) of the remaining 189 articles present empirical work, and 7% feature conceptual/review papers. As illustrated in Table 7, the empirical research builds on qualitative methods in 11% of the cases and on quantitative methods in 89% of the cases. Some 3% of the articles utilise a mixed-method approach.

Table 7. Research methods used by studies (N = 189).

Research methods		No. of papers	% of No.
Qualitative		20	10,58%
	Interviews	10	5,29%
	Case-study	7	3,70%
	Critical incident	2	1,06%
	Mixed (interviews, observations)	1	0,53%
Quantitative		151	79,89%
	Survey, questionnaire	142	75,13%
	Experiment	1	0,53%
	Diary	3	1,59%
	Experiment and survey	4	2,12%
	Expert opinion	1	0,53%
Mixed		5	2,65%
	Interviews and surveys	2	1,06%
	Case studies (interviews) and surveys	1	0,53%
	Interview and focus groups	1	0,53%
	Survey and quasi-experiment:	1	0,53%
Others		13	6,88%
Conceptual/SI review articles		4	2,12%
Systematic review/bibliometric analysis/meta-analysis		9	4,76%
Total		189	100%

4 Thematic mapping of KH studies

KH in the workplace is influenced by various factors related to leadership, job characteristics, social resources, and the workplace environment.

- **Leadership factors**. Leadership style and leader-member relationship directly affect knowledge hiding in the workplace. Leaders who adopt a directive or controlling leadership style are more likely to induce knowledge hiding in their subordinates, and employees who have a weak relationship with their leaders may not trust them with confidential information (Feng et al., 2022; Koay and Lim, 2022; Agarwal et al., 2022; Scuotto et al., 2022; Oubrich et al., 2022).
- **Job characteristics**. Job autonomy, job overqualification, and job territoriality are job-related factors directly affecting knowledge hiding in the workplace. Employees with a high degree of job autonomy, are overqualified for their jobs or are territorial about their job responsibilities may hide knowledge from others (Singh 2019; Ma and Zhang, 2022; Shafique et al., 2022).
- **Social factors**. Social resources and job insecurity are social factors that directly affect knowledge hiding in the workplace. Employees with access to social resources, such as a supportive network of colleagues, are likelier to share knowledge than those without. Conversely, employees who feel insecure in their jobs may be less likely to share knowledge (Kmieciak 2023; Shoss et al., 2022; Wang et al., 2022)
- **Workplace environment**. Conflicts in the workplace, work ostracism, workplace bullying, negative workplace gossiping, competitive climate, organisational politics, and organisational justice are environmental factors that directly affect knowledge hiding in the workplace. Employees who experience workplace conflict or bullying may feel that sharing knowledge could put them in a vulnerable position. Similarly, employees who perceive a highly competitive or political work environment may be more likely to hide knowledge. Finally, employees who feel their organisation is unfair or just may be less motivated to share knowledge with others (Bhatti et al., 2023; Khan et al., 2023; Yao et al., 2020; De Clercq et al., 2022; Kaur and Kang, 2022).

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Innovation Integrality Index: A Tool to Integrate Rational and Emotional Sides of Innovation in the Organizational Resilience

Francisco Javier Álvarez-Torres*

Department of Natural and Exact Sciences
University of Guanajuato
Mexico

Giovanni Schiuma

Department of Management, Finance and Technology
LUM University
Italy

* *Corresponding author*

Abstract

Nowadays, we are facing a world in social and economic compulsion. Different kinds of crises and shocks in the economic and social systems crashed in our reality. This is creating a chaos and uncertainty environment among leaders, entrepreneurs and organizations. It is precisely in this moment of uncertainty that an innovator and resilient leader can identify new opportunities to integrate emotions around an organization. These innovators and leaders are struggling with this issue and sought ways of working and continue daily activities. In essence, these leaders are adding resilience into the organizational culture using two sides: rational and emotional sides of innovation. For that reason, understanding resilience and innovation as a symbiosis is a guide for modern organization. This relationship is a priority for many organizations, actors and governments in the current scenario of changing. Under this context, having an index that measures dynamics and main practices (rational and emotional sides) around a culture of innovation allows us to know and recognize how does our organization resilience react front a major economic impact. In the case of the study, the application of the instrument was carried out during the months of September to December 2022 to 177 managers and/or founders of small and medium-sized companies in the state of Guanajuato, México. We use a Partial Least Square Equation Model (PLS-SEM) methodology to prove validity into relationships and sample size. We draw on our findings detecting that managers mostly are focused on the rational side of innovation (resources, processes and successes) and less on the emotional side (values, behaviours and work environment). This finding provides an opportunity to improve this emotional side of innovation, because this is a core element to enhance

resilience in organization. We recommend further development and evaluation of future approaches about leadership, innovation and resilience.

Keywords - innovation, resilience, emotional, SMEs, management.

Paper type – Practical Paper

1 Introduction

Innovation is a key element for survival and for developing a competitive advantage from over competitors (Arenhardt et al., 2018). COVID-19 pandemic showed us how the capacity of adaptation of a company to innovate made a difference in survival and future relationships with customers and other actors in the ecosystem. We believe that during a crisis (real or perceived) innovation's culture of a company activate two sides during adaptation process, integrating emotional and rational sides.

For that reason, having an analysis of the dynamics and practices about innovation during a crisis would develop a future index that measure of innovation in this integrality of emotional and rational sides and how affect resilience in an organizational environment. This allows us to know and recognize different effects on resilience strategies depending on innovation.

The objective of this research is to analyse how dimensions of the innovation culture of a company integrates an index with two sides: emotional and rational. And how this is a key element to improve resilience inside organization. To do that, we use a sample of SMEs in the state of Guanajuato where we evaluate six dimensions. There is a database of 177 companies in the region of the state of Guanajuato. The interview phase was carried out during the months of September to December 2022, by various means, both digital and face-to-face, although due to health issues, the first was chosen as the most used option.

2 State of the art or literature review

2.1 Innovation is changing.

Innovation is a fundamental process for the development of a dynamic economy. There are several ways to define it, but if we look in the contextual origin, we can observe how this concept have evolved during time. Since ancient

Greek philosophy where innovate were related with terms of imitation and invention until our days where era of technology, consumerism, and industrialization have established a relationship with innovation.

However when innovation is mentioned as a concept in the literature, it inevitably invites us to frame it from the paradigm of economic development, in which Schumpeter (1934) through his work provided a frame of reference in the first decade of the 20th century. For the author vision, during production processes occurs an interaction where *tangible* and *intangible* forces interacted in new economic cycles, creating, destroying, and recreating products, services, and markets. This argument it might be assumed that innovation process it is just an economic stage, and nothing related with a human emotion, this mindset of a rational view (Weber et al., 1947) of innovation gives us such assumptions related to a rational, machine-like view, *where any emotional experience of innovation is minimized for managers and leaders who only deploy rational strategies for a company's profits*.

Our pragmatic approach toward innovation process recognises that exists an *integrality between rational and emotional actions* where leaders and managers reflect emotions and rational decisions in a company. In a complex, turbulent and uncertain business environment as we are living, integrate emotions in innovation process creates an opportunity to focus research on resilience for managers or leaders.

For that reason, we used an adaptation of the Rao and Weintraub Model (2013) for an analysis of the culture of innovation through the vision of the general managers and/or founders adding these emotional and rational elements, creating an *index of integrality*. This index provides invaluable assets to decision makers for the promotion of elements towards a culture of a dynamic concept of innovation (Edwards-Schachter, 2018). *Integrality Innovation Index* includes *rational and emotional* approaches to develop a mindset of innovation where emotions play an important role in an uncertainty environment for organizations and leaders who are seeking resilience among teams' company.

In our current context of industrial and technological change something is happening with innovation and production relationship. Schumpeter (1934) anticipated this when he mentioned that when occurs an increase in production depends directly on the relationship of the productive factors and the rates between technology and the value exchange of the socio-cultural environment of the time. This means that when elements related with intangible fields

(knowledge) tangible (raw materials) and value of cultural context determines combinations and therefore the effect of innovation in society and companies.

The foregoing is related to what was mentioned by several authors who points out the importance of resilience, emotions and innovation relationship in our current cultural context (Dyer et al., 2008; Valor et al., 2022). For example, Martin (2016) points out the importance of sustainability in this second half of the 21st century and how this paradigm will determine the type of innovation in which it will be invested, perhaps giving birth to dark ways of innovation, this being the real challenge of managing innovation in the 21st century in environments of uncertainty and accelerated change.

This process of contextualizing how innovation is changing allow us, from this work, to address a relationship between the work of Schumpeter (1934) and what the Global Entrepreneurship Monitor (Global Entrepreneurship Research Association, 2017) mentions about economies at a global level. This report establishes the connections between innovation, entrepreneurship and quality of life in various countries. Its recommendations recognize the need to integrate innovation not just from a rational stand but as an 'social glue' into the business and social agendas of large, small and medium-sized companies and social environments to promote revitalized emotional environments. The challenge is to facilitate the conjunction of these ecosystems and coordinate various levels of government, the educational sector and the private sector.

As mentioned, innovation is a lever for the economy and for new economic cycles. Without it, entropy would generate less benefit for all actors and the generation and accumulation of wealth would stop (Suárez, 2004). For various authors and tools, the measurement of innovation allows contributing not only with an expansion of the concept from pragmatic fields, but also allows attending to the context in question. For example, according to the Oslo Manual (OECD/Eurostat et al., 2005), innovation can be presented in various forms and tangible products, but also in the development of customer service campaigns, such as through marketing. In summary, innovation can have various forms (Edwards-Schachter, 2018; Kogabayev & Maziliauskas, 2017; Martin, 2016), however, it is possible to classify it according to its attributes:

1. Depending on its nature: Product, process and business.
2. Depending on the form: Technological and organizational.
3. Depending on the geographical impact: Company, local or international market.

4. Depending on the impact on the market: Incremental, semi-incremental, radical.
5. Depending on the objective: Occasional and intentional.
6. Depending on the internal culture of the company: Focused (areas or departments) and systemic (organization).
7. Depending on the use of systems, tools or methods: Empirical, experimental, methodological or systematic.

Although there is work in the literature to define innovation, there is an area of opportunity to investigate how of innovation is moving and its new characteristics and realities as resilience and emotions. That is to say: *How emotions affect innovative capacity? What determines an environment of innovation in a turbulent world? What characteristics of innovation are linked with resilience?*

Crisis not only give us opportunity to create new practices, businesses and dynamics but to re-create concepts as innovation. COVID-19 pandemic was a great teacher for that, left us with something and it was the debate around the generation of new ecosystems of economic growth and how to relate it to the systematic search for innovation (Donthu & Gustafsson, 2020). The economies that aspire to become leaders in this new paradigm must decide for a high investment in resilient human capital with high capacities for innovation and entrepreneurship. Crises would shake the world in short term (World Economic Forum, 2023), but those who stand out are those who take the stage as an opportunity to create new niches and markets. The challenge of the new economy is creating organizations based on collaboration, innovation and resilience as core of production process. *Innovation that generates value is changing and now is emerging an ethical and emotional approaches where their performance outcome is not only in financial fields* (Bakhshi et al., 2017). In this paradigm, if a company, especially a small or medium-sized, commits to strengthening a culture of innovation and incorporates an emotional side of it.

Innovation therefore is not just a consequence; it is a key element in the birth of a successful organization. It is directly associated with the acceptance of products or services in the market and generates better returns in companies that visualize and execute it in the various areas.

2.2 Emotional and Rational Sides of Innovation: Resilience.

Imaging an integration where productive factors, socio-cultural environment and technology (Schumpeter, 1934) give us natural tensions where resilience plays a crucial role in innovation process. Complex, turbulent and uncertain business environment creates scenarios for a resilience management perspective, which according with research enhance organizational innovation (Richtnér & Södergren, 2008). Resilience is viewed as the return of an equilibrium state of our environment (De Noronha & Pinto, 2016) and become one of the key competences for future (World Economic Forum, 2020), for that reason a relationship between innovation and resilience allows to any organization to create and develop a capacity to *absorb these shocks* without losing *innovation mindset* and even creating a new one (equilibrium). Resilience with an innovation culture allow to recognize how these different levels of re-covering, re-shaping and re-orientation of economic and social systems are integrated in the organization (in a rational and/or emotional side).

From a managerial point of view, *managers and staff need to develop a capacity of resilience in order to generate creative scenarios for organization, in this process they need to put focus on soft skills in addition to other resources* (Richtnér & Löfsten, 2014). This is a real challenge, because managers need to use both sides of innovation (rational and emotional) with expertise to cope turbulence situations and boost creativity among people.

Company culture is the software of its social technology, making a technological analogy. It belongs to the dynamics, behaviors and internal rituals that allow the generation of new connections between people or areas or, where appropriate, hinder the development of projects.

The management in terms of innovation allows the company to evolve or disappear according to the challenges that each context provides. And in the literature, although there are studies on innovation and organizational performance (Alvarez-Torres et al., 2019; Bach et al., 2019), there is no single formula for a certain culture can achieve success.

An innovation management process that *uses emotional and rational sides should be mainly oriented towards comprehensiveness with the vision of the company*, its workers and its processes, and must consider both the skills and emotions of the human talent that integrates the workforce, market and the purpose of the organization and how its main actors and technology add to that

great creative force that emanates from the organization creating a resilient environment. *The integrality of these elements should be a central point of a creation of a culture of innovation with a resilience perspective since it refers to the fact that should be aligned and configured to obtain the greatest potential of the organization in accordance with its values and resources*. It is not just innovating for the taste of innovating, but the meaning and ethical significance of contributions to the market.

Although the culture of the organization is a fundamental axis to promote or hinder innovation projects and advances. As research showed us, there are norms, beliefs or values, both individual and organizational, that allow sheltering or limiting efforts in innovation and creativity (Zhou et al., 2019). A culture of innovation provides practices, narratives and environments willing to generate connections between senior management staff and operational staff, stimulating risks and therefore the right ground for a possible entrepreneurial management (Alvarez-Torres et al., 2019).

Those organizations with a prioritization of discipline, authority and individual work lack the structures to become an innovative organization. Rigidity limits creativity and autonomy, that is, it corrupts integrity. The creative digital new business setup seems to require other types of structures (Lyytinen et al., 2016) and if these are not adopted in the medium term, it would seem to put the survival of traditional organizations in the market at risk. Change in this sense is not easy, since it requires horizontal, improving emotional sides of innovation and open-active communication.

2.3 Innovation and Resilience relationship: Leadership is the key.

COVID-19 pandemic showed us new limits about technological and human adaptation to new conditions, in an uncertainty world as we lived, we are not very resilient to error or failure. This scenario gives us serious organizational conditions to push innovation, leadership and soft skills of personnel. Be resilient could be defined as capacity to remain stable or back to a form of stability when it is perturbed. It is a limited capacity but also an invisible asset. This is curious, because this means the core of resilience in organizations are people and its daily dynamics among work and co-workers. Most companies trade resilience for innovation after pandemic. The main reason is: "nothing is stable as it seems". This is controversial and even dramatic, especially when leaders and managers

should appear with a solid business or operation plan for next quarter. And give us one of the main actors of innovation-resilience relationship: Leadership. Little is mentioned in literature, but when it is done is highly mentioned in contexts of rapid change as digital environments (Belair-Gagnon & Steinke, 2020). This could mean a future research question focusing *how leadership is developed with resilience in highly demand environments as full-digital?* In that sense, it is necessary to address any relationship between innovation and resilience from top management, since as the person responsible for the strategy, the organization's approach, the use of resources and the reinforcement of practices, it is the one that allows defining the dynamics and values around error, innovation and creativity. If top management does not play with these principles, it is very difficult for innovation with any paradigm or guide to be a priority.

The challenge of innovation is to make all leaders, managers and middle managers be facilitators and promoters of innovation in the organization's environment, however, people must be able to take risks supported by senior management and in the same not trade full resilience capacity by innovation capacity (Volberda et al., 2013). But the weight of innovation does not only lie in the leaders, but the true gene is also found in the people, who, although supported by a good structure, access to resources, can make a difference. However, it is more complex to have the infrastructure but not the people trained for this purpose. Measuring how people innovate in a context is a fundamental element to understand a culture of innovation. Some organizations have chosen to reward innovation efforts individually, others collectively. Valuation is not always economic, but it is one of the elements that was measured in the model of this research (Rao & Weintraub, 2013).

2.4 Rational Side for Innovation and Resilience.

Managing an innovative organization is either a chaos or a virtue for any modern organization. Since the challenge requires a structure that facilitates change, rewards mistake and facilitates both individual and collective creativity (Robinson & Aronica, 2016). A flat structure with few levels of hierarchy tends to favor innovation, while a pyramid-like structure limit it. Some organizations choose to centralize activities in a department designated for this purpose and although it could work in some contexts, in the reality of our country it can generate more steps, obstacles or excessive bureaucracy (Domínguez, 2010;

OECD, 2009). This is a traditional view of innovation, as we described as *rational side*. Structure, resources, hardware and software are vital to visualize working in projects or to take responsibility in innovation area. In this *side* most managers visualize strategies to maintain control and efficiency. For example, a good strategy of automation will increase efficiency in a motor company, but it is probable to reduce transparency of operations and eliminates any human motivation to express emotions. Innovations in rational side could be like a control inventory management to improve resources as time or raw material, but they make it difficult for a company to adapt new conditions in a crisis. In this mindset of innovation, resilience could be adapted as a system, of course with limitations.

2.5 Emotional Side for innovation and Resilience.

Resilience influences potential for leaders and managers to future innovation and how deal with failures and errors during innovative process (Moenkemeyer et al., 2012). This behaviour is key to push an *emotional side* of innovation inside organizations. *How people deal with stressful events? How people react to failure or errors? Is the organizational culture resilient when an error or a crisis happened?* Resilience is a lever for innovative culture and keeps functioning and acquiring experience dealing with crisis and variables about uncertainty. However, very few organizations have a formal element about innovation and resilience management. In the Mexican case, Small Medium Enterprises (SME) companies and educational institutions have overcome a couple of years of chaos in terms of performance and talent retention (Schmelkes, 2020). Especially a crisis in the acquisition, retention and motivation of talent, a crucial element when we talk about *soft skills*. In that sense, to promote the innovation process within an organization is real challenge, because innovation is transforming ideas into value and knowledge, resilience is keeping order, so balance needs entails talent and a suitable environment where evaluating, organizing, experimenting, investing and developing is a constant dynamic. Embracing the power of an emotional side of innovation and its practices.

Establishing a methodology to measure whether the culture of innovation is conducive to certain processes or interventions is an essential issue for the ecosystem and companies. Including an emotional side could give us information about some elements for resilience. Although its measurement is difficult due to

the multiplicity of factors, we adapted Rao and Weintraub (2013) model, where it is possible to have a measurement of the various basic components of an organization's culture of innovation. According with this, we develop *Innovation Integrality Index,* which is the result of measuring innovation in six dimensions, three for a rational side and three for an emotional one. The index allows defining possible actions to specify a culture of innovation in a company.

3 Methodology

To carry out the study, managers of 177 SME companies in the state of Guanajuato from various sectors were interviewed. For this, the cultural adaptation of the instrument developed by Rao and Weintraub (2013) was carried out with 54 closed items evaluated by a Likert scale with 5 response possibilities. The information was analysed considering 6 dimensions. The proposed model allows evaluating the key areas of the organization: *The rational area of the business and the emotional*. To carry out the study, the General Manager of the Company or Founder was interviewed by face-to-face and/or digital means. To carry out the statistical verification and validation process, the partial least squares structural equation system (SEM-PLS) was used (Hair et al., 2010; Iacobucci, 2010) its relevance in the use of small samples. The research model has six reflective dimensions (see Figure 1) (Becker et al., 2012). The dimensions make it possible to portray the phenomenon of innovation dynamics in the SMEs surveyed and allow the results to be discussed considering the implications for the post-Covid economic recovery.

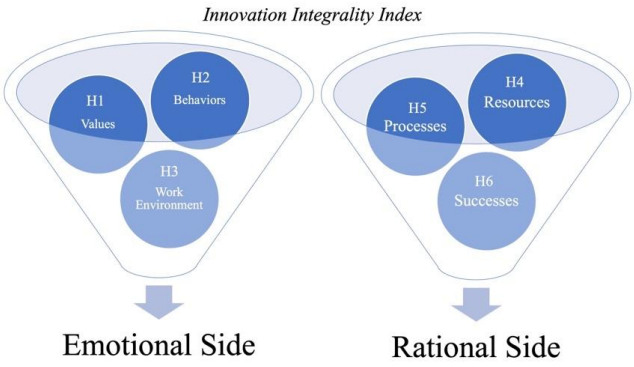

Figure 1. Theoretical model adapted for research. Adapted from Rao & Weintraub, 2013.

The six dimensions evaluated consider the following elements of the Rao & Weintraub Model (2013):

Table 1. Dimensions and Sides of the model.

Emotional Side of Innovation	**Rational Side of Innovation**
1. Values.	4. Resources.
2. Behaviours.	5. Processes.
3. Work environment	6. Successes.

From the above, six hypotheses were derived about the dimensions of the Model:

Hypothesis 1. The Values dimension is positively and significantly reflected in the Innovation Integrality Index.

Hypothesis 2. The Behaviors dimension is positively and significantly reflected in the Innovation Integrality Index.

Hypothesis 3. The Work Environment dimension is positively and significantly reflected in the Innovation Integrality Index.

Hypothesis 4. The Resources dimension is positively and significantly reflected in the Innovation Integrality Index.

Hypothesis 5. The dimension of Processes is positively and significantly reflected in the Innovation Integrality Index.

Hypothesis 6. The Success dimension is positively and significantly reflected in the Innovation Integrality Index.

To apply the PLS-SEM methodology, it is necessary to design the Type I reflective model (Becker et al., 2012) in the SmartPLS® version 3.3.3 software (Ringle et al., 2015) for the 177 observations. For evaluating this type of models, it is necessary to analyze the load of the indicators. Loads greater than 0.700 indicate that the construct explains at least 50% of the variance of the indicator, which is why the indicators lower than this parameter were removed. In this case, the eliminated items correspond to item 2 of the Values Dimension (0.403), item 3 (0.175), item 5 (0.664) and item 9 (0.669). Being the dimension that more items were removed from the index. Item 24 of the Work Climate Dimension (0.612), item 25 (0.179) and item 26 (0.557). Item 54 of the Success Dimension (0.557). Item 41 of the Processes Dimension (0.643) and 43 (0.647). Similarly, item 14 of the Behaviours Dimension (0.673).

The next step in the validation of the model is to analyze the reliability of internal consistency for the use of SEM-PLS, it is determined through the composite reliability, which determines that for exploratory studies the margins of 0.600 to 0.700 are acceptable, parameters between 0.700 and 0.950 are considered satisfactory and excellent and those greater than 0.950 are problematic. The dimensions obtained scores greater than 0.850 and less than 0.950 (see table 2).

Table 2. Innovation Integrality Index reflective model measurement settings.

Dimensions		***Composite reliability***	***AVE***
Innovation Integrality Index	Values (V)	0.876	0.586
	Behaviours (C)	0.936	0.619
	Work Environment (CL)	0.903	0.608
	Resources (R)	0.925	0.577
	Processes (P)	0.921	0.595
	Successes (E)	0.934	0.638

Source: Own elaboration based on the information obtained by SmartPLS®

The next thing in the validation process is to analyze the Convergent Validity, which is determined by the Average Variance Extracted (AVE). This indicator is calculated by the mean of the square of the loads of all the indicators associated with that construct (Sarstedt, Ringle, Smith, et al., 2014). An acceptable AVE corresponds to 0.500 or greater (see table 2), which is fulfilled in the proposed Model. After the previous tests of the model, it is necessary to determine the Discriminant Validity. This determines how different a construct is from others in the model. The most conservative way to do it is through the Fornell-Larcker criterion (Hair et al., 2014) (see Table 3).

Table 3. Fornell-Larcker criterion.

	V	***C***	***CL***	***R***	***P***	***E***
V	**0.766**					
C	0.651	**0.805**				
CL	0.647	0.736	**0.780**			
R	0.713	0.726	0.765	**0.760**		

P	0.669	0.638	0.733	0.854	**0.788**	
E	0.643	0.658	0.664	0.850	0.777	**0.799**

Source: Own elaboration from the information obtained

The next step is the evaluation of the structural model. For this, the following are evaluated: a) determination coefficient (R2), b) cross-validation redundancy (Q2) and c) path coefficients (Sarstedt, Ringle, Smith, et al., 2014) (see table 4).

Table 4. R2, adjusted R2 and Q2 of the structural model.

	R^2	R^2 Adjusted	Q^2
V	0.624	0.622	0.355
C	0.709	0.708	0.454
CL	0.733	0.732	0.431
R	0.889	0.889	0.503
P	0.792	0.790	0.485
E	0.793	0.792	0.494

Source: Own elaboration based on the information obtained by SmartPLS®.

The R^2 indicator is a measure that allows us to predict the results of the model. Values between 0.660 and 0.330 indicate a moderate explanatory value of the model. All six dimensions possess this characteristic. Another way to evaluate the predictive relevance of the model as a measure of precision is Q^2, as measured values greater than 0 indicate an acceptable predictive value (Hair et al., 2014; Sarstedt, Ringle, Henseler, et al., 2014).

Table 5. Hypotheses, path coefficients, t value and significance of the structural model.

Relationships and Hypotheses	*Sides of Model*	*Coefficient Path*		*Values t*
Hip. 1.		0.790	***	20.926
Hip. 2.	Emotional Side	0.842	***	27.972
Hip. 3.		0.856	***	39.690
Hip. 4.		**0.943**	***	115.718
Hip. 5.	**Rational Side**	**0.890**	***	48.322
Hip. 6.		**0.890**	***	49.927

*** p < 0.001. Source: Own elaboration based on the information obtained by SmartPLS®.

Bootstrapping was carried out with 5,000 subsamples (Sarstedt, Ringle, Smith, et al., 2014) obtaining six relationships between the variables (see table 5). Through the results, it can be observed that the index is reflected in a *positive and significant* way with a higher coefficient for the dimensions of *Resources* (0.943), *Processes* (0.890) and *Successes* (0.890), the *Rational Side* of Innovation.

4 Discussion of Results

Six hypotheses and validity of model were accepted, next step of results analysis is frequency data. In that issue, results indicate that more than 50% of the companies surveyed represent micro-small companies that have between 10 and 50 workers.

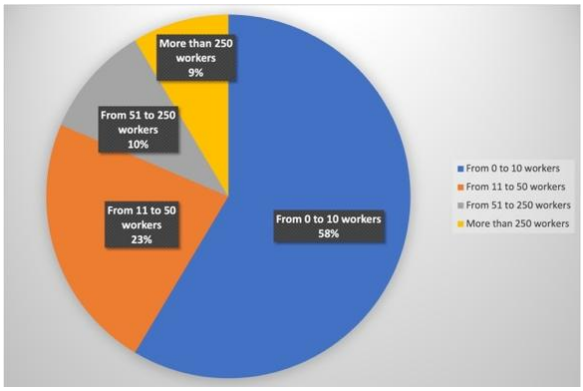

Figure 2. Percentage of sample of companies interviewed by number of workers. Source: Own elaboration with Google tools.

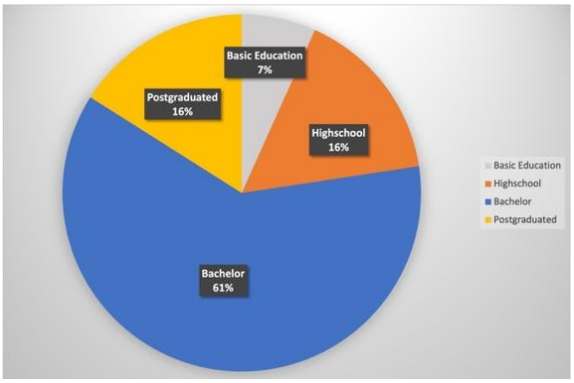

Figure 3. Percentage of sample of people interviewed by schooling. Source: Own elaboration with Google tools.

In terms of schooling, 61.4% of the managers indicated having a bachelor's degree, which may indicate an educational capacity when they're applying a managerial skills in the state of Guanajuato (Jiménez et al., 2015), a phenomenon that would be worth considering in the future research. In what corresponds to the preparation in innovation issues, the group has two very marked tendencies. 50.3% indicated having previous training and 49.7% mentioned not having it.

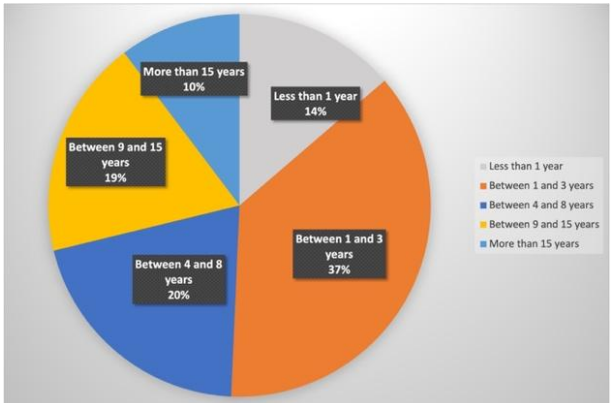

Figure 4. Percentage of sample of people by seniority in the company. Source: Own elaboration with Google tools.

Seniority in a company symbolizes stability but could also minimize the orientation to innovation, especially if there is no Career Plan, in the case of the sample more than 50% of the sample indicates having between 1 to 8 years. The descriptive analyses allow us to portray a panorama of SMEs in the state of Guanajuato, in which the majority (48.7%) are young companies. This allows us to infer that the innovation processes that are portrayed in the analysis are mostly reflected by this type of company, in which the *Resources dimension (0.943) is a very valuable area for the creation and development of an innovation culture, meaning that a rational view of innovation is hardly in the core of strategy.*

In the case of the values dimension and emotional side, the *items related to exploration, creativity and experimentation reflected a higher factorial load and the items related to tolerance to failure and error were eliminated as they did not have the necessary factorial load to form part of the dimension.* This is an important finding in the research. It seems that creativity and experimentation are dynamics that can exist well on paper but not in practice, since experimenting or creating implies errors or failures. This element is crucial, because they're antecedents for an resilient environment (De Noronha & Pinto, 2016).

According to the results in the work environment dimension, the items related to autonomy, taking responsibility or an orientation towards more flexible norms or structures were the ones that did not have the factorial load necessary to be reflected in the index. However, the language of innovation and teamwork stood out in this dimension (See Figure 5).



Figure 5. Adapted Model of Innovation Integrality Index. Made with SmartPLS®. Own elaboration.

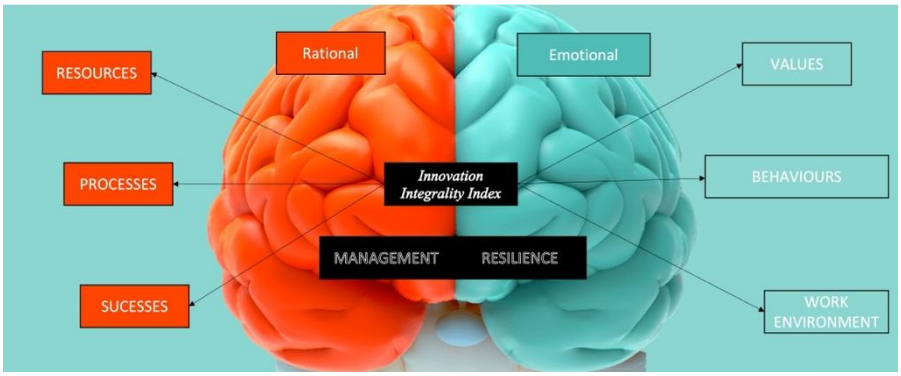

Figure 6. Model of Innovation Integrality Index integrating rational and emotional side of innovation. Own Elaboration.

5 Conclusions

According to Rao and Weintraub (2013) when it comes to promoting innovation in organizations, in general it is essential that managers and directors pay special attention to the six dimensions, however, *resources, processes and successes stand out because they form the more rational side of innovation and is somehow easier to measure*. In the sample of SME companies surveyed, it reflects these dimensions. What corresponds to a more emotional approach to innovation that corresponds to values, behaviours and work environment, intimately related to people, does not seem to be reflected in the same way in the orientation of managerial decisions.

During process some managers reported the main importance of soft skills during a crisis moment, especially during COVID-19 pandemic (values, work environment and relationships) and how these skills provide a secure and resilient scenario for better communication and self-awareness of what's going on around company. Managers appeared to build innovation strategy from automatic reactions "to manage" innovation as only focusing resources and results. The challenge for them is including emotional situations and taking responsibility to communicate with emotional and resilient competence. This kind of leadership has a potential, but it needs strengthening cognitive, behavioural and contextual capacities around a resilience organization perspective (Nzinga et al., 2021).

The lack of an emotional side could be analysed as a negative point, but also as an area of opportunity to improve the management of talent and human resources to promote innovation from a more emotional aspect, which involves the promotion of values and behaviors that cover the key processes of

innovation. The human is the key in this post-covid era, however, in a complex environment it also seems the most difficult to address. However, these dimensions are the ones that could shape a new culture of innovation and create present and future competitive advantages.

Although the results allow dimensioning a reflection towards a culture of innovation of the companies surveyed, the risk of developing a single block, such as the rational one, is a weakness in the medium and long term for the companies of the region, especially for a learning towards the automation and digitization of administrative and production processes. Well, an orientation towards innovation from people could attract better talent to the organization.

The analysis of SMEs allows identifying areas of training, qualification and education for the managers of this type of company in emotional sides of innovation (See Figure 6). This means plans to structure continuing education programs inside company teams to shore up the weak points of a culture of innovation oriented by resilience.

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Does Gender Enter into the Non-Performing Loans' Management?

Mauro Paoloni

Business Studies Department
University of Roma Tre
Via Silvio D'Amico 77, 00145 - Rome

Valentina Santolamazza*

Business Studies Department
University of Roma Tre
Via Silvio D'Amico 77, 00145 - Rome

Beatrice Elia

Engineering Department
University of Roma Tre
Via Vito Volterra, 62, 00146 - Rome

* *Corresponding author*

Abstract

In recent years several routes have been entered to face the existing discrimination in the access to credit between male and female. In this framework, the initiatives undertaken by the United Nations and the national governments have shown growing attention in order to alleviate the gender gap in various economic sectors. Among those, the non-performing loan one, given the recent economic and pandemic crises, is registering a fast increase. The objective of this work is to examine if and how gender is considered among the evaluation criteria of non-performing loans (NPLs) portfolios.

An inductive content analysis has been carried out on 30 documents relating to NPLs. Specifically, the sample is made up of official publications and reports published on the websites of European and National Institutions, supervisory authorities, main banks groups, specialized sectorial consultancies and leading servicers.

The analysis of the documents shows that, at present, gender is not particularly taken into consideration when banks and servicers illustrate their NPLs portfolio. On the contrary, it is possible to find classifications based on other variables (e.g. geographical position, business sector or presence of guarantees). Therefore, it is possible to conclude that gender – so far - does not appear to be an element that is considered when discussing the management of NPLs.

This work is the first part of broader empirical research intended to open a debate about the relevance of the gender factor in the management of NPLs. In fact, while the gender variable seems to be taken into account as an element for granting credit, it is not considered for its management.

Keywords – Female-run business, Asset quality management, credit crunch, gender diversity, non-performing exposure

Nature of proposed paper - Academic Research Paper

1 Introduction

Access to credit and financing is a topic of great interest in studies on female entrepreneurship, which have shown significant differences between male and female businesses, seeing the second category as more disadvantaged than the first (Paoloni, 2011).

However, the attention paid by the International and National institutions to female entrepreneurship and gender equality is gradually reversing this trend in almost all economic sectors. Through an in-depth analysis of the content of several cases and official documents recovered online, this work aims to understand if the secondary financial market is aligned with this gender growth model. The research question (RQ) examined is: "*Does gender somehow enter into the management of a bank's credits portfolio, and in particular into the management of non-performing loans (NPLs)?*". According to the European Central Bank, "groups of loans created to estimate allowances on a collective basis should be sufficiently granular to ensure that grouped exposures have shared credit risk characteristics so that banks can reasonably assess changes in credit risk and their impact on the estimate of allowances" (European Central Bank, 2017). From the analysis literature, women's enterprises have some peculiar characteristics that allow homogeneous classes to be determined since some studies demonstrate their higher credit quality (Paoloni, 2011; Mustapha, 2016; Cesaroni and Stentuti, 2015).

The stock of NPLs, in the last twenty years, due to the successive financial crises and the recent pandemic, has considerably increased to bring out the need for specialized operators (Paoloni *et al*., 2020). But which characteristics does the market have? What criteria do banks and sector operators adopt to evaluate NPLs' portfolios? For example, is gender used as a criterion? If yes, by whom was

it initially suggested or regulated, and what benefits does it present? If not, what are the reasons, and what are the reasons for its inclusion?

To answer these questions, the authors first proceeded with an analysis of the literature on the origin of NPLs, both from a business and legal point of view, as well as the possible correlation between female entrepreneurship and creditworthiness (Section 2). Subsequently, the authors proceeded with the content analysis of selected documents to identify which are the segmentation criteria used (Section 3). From the analysis (Section 4), it emerged that this sector is still fragmented and far from complete harmonization. Supranational Institutions have carried out the greatest sectorial assessment production, however, with scant attention to a specific identification of portfolio classification criteria. When these criteria are present, they mainly refer to general classifications, such as geographical position, business sector or presence of guarantees. The results lead authors to conclude, in Section 5, that the gender variable is neglected by the main actors of the sector, completely in contrast with the evolution of the literature or, in any case, with respect to other similar or/and collateral sector trends, which have recognized female-run businesses as having greater solvency and, therefore, a better ability to repay debt in any cases of insolvency.

2 Literature Review

2.1 The origin of Non-Performing Loans

Non-performing exposures (NPEs) are an umbrella term for various defaulter debtors. In the past ten years, the legal system has identified specific criteria that distinguish NPEs from other types of defaulter loans, such as the likelihood of recovering the debt (Capriglione, 2019). Studies in this area have focused on examining the circumstances where the potential loss is beyond the normal range, necessitating an evaluation of the magnitude of the debt and its distinguishing features.

Specifically, when talking about NPEs, it is possible to identify three categories which are distinguished according to the different probability of recovering the credit at maturity (EBA, 2014):

- The expired and/or exceeding exposures (Past Due), that have exceeded the lending limits by more than 90 days;

- The Unlikely-To-Pay (UTP), that are exposures for which the bank considers it unlikely that the debtor will fulfil his contractual obligations without resorting to actions such as the enforcement of guarantees;
- Non-Performing Loans (NPLs), which are exposures towards subjects in a state of insolvency or similar situations.
- From a business perspective, non-performing loans are specifically generated by a company's inability to meet its financing needs conveniently, timely and satisfactorily, an element necessary for an enterprise to be profitable (Zanda, 2015; Paoloni and Paoloni, 2021). The reasons that can produce this situation are:
- Severe financial imbalances, in that firms cannot find the appropriate financing sources to meet obligations;
- Economic imbalances, in that firms run businesses that do not generate enough revenue. Therefore, this permanent situation has a negative effect on the company's equity.

From a legal point of view, the definition of NPLs has undergone several changes, made necessary by the contingent situations that led to the explosion of the problem around 2012-2013, following and reflecting the financial crisis of 2008 (Capriglione, 2019). As seen before, NPLs are exposures to entities in the insolvency or substantially similar situations. The state of insolvency is manifested by defaults or other external facts, which show that the debtor can no longer meet its obligations regularly. Therefore, an NPL arises from a continuous and ongoing contractual default of a party towards its creditors.

For obvious reasons, the topic of NPLs has always been linked to the banking sector, as companies whose business, in part, is based on lending resources to other companies (Cucinelli, 2015; Paoloni *et al*., 2020).

Following tightening regulations after the 2008 economic crisis, banks implemented several policies to reduce the NPL phenomenon. While on the one hand, specialised NPL management businesses have sprung up, on the other hand, banks have also started to decrease and weigh their investment choices. This has led to a credit contraction but, even more generally, to a greater focus by banks on whom they lend money (Cucinelli, 2015).

Previous literature on NPLs has tried to understand the variables that affect NPLs' waves (Khairi *et al*., 2021).

Several studies linked NPLs to macroeconomic variables (such as GDP growth, unemployment, and inflation) (Kauko, 2012; Louzis *et al*., 2012, Beck *et al*., 2015).

In addition, the uncertainty in economic policies has also been identified as a factor affecting credit risk since changes to economic policies can lead to the misallocation of banks' credit resources or deterioration of borrower firms' operations (Chi and Li, 2017). Kauko (2012) researched the connection between the current account and the development of NPLs during the recent financial crisis, showing that macroeconomic factors, rather than banking sector solvency and liquidity, are the main drivers. All these studies have as their main idea that the NPL phenomenon depends on variables exogenous to the banks' control.

However, some other studies have identified bank-related variables (such as bad management) as the main factors that affect NPLs (Anastasiou *et al*., 2019). In addition, other studies have identified the banks' governance composition as a factor that could limit the presence of NPLs (Lafuente *et al*., 2019). For example, a study (Tarchouna *et al*., 2017) identified that, before the 2008 crisis, big and medium banks were more likely to fail in that directors had more liquidity to invest and put banks over an adequate level of risk. This did not happen in small banks with no available resources to invest. Therefore, these studies focused on a second category of variables, specifically banked-related factors.

Among the most critical aspects of banking variables is the proper management of credits. This aspect consists of correctly selecting and evaluating credits to be disbursed and knowing how to manage NPLs when they are generated. In this sense, a third category of factors influences the creation of NPLs, namely the characteristics of the companies to which credit is given is identifiable. However, this category (which can be defined as microeconomic factors) has been developed by existing literature directly concerning credit quality (e.g. Ashbaugh-Skaife *et al*., 2006) rather than NPLs.

Therefore, it is interesting to analyse whether firm-specific characteristics are directly related to the presence of NPLs.

2.2 Female entrepreneurship and creditworthiness: is there a link?

Business studies have identified many criteria for analysing companies: based on sector, size and geographical location. A feature that has been finding ample space for analysis in entrepreneurship studies lately concerns gender (Ramadami, 2015; Dal Mas and Paoloni, 2016). In the last 30 years, female entrepreneurship is a growing phenomenon, also thanks to various measures that attempt to close the existing gender gap also at the entrepreneurial level (Paoloni, 2011). However,

the path of a woman entrepreneur is often characterised by several difficulties, such as acquiring funding, balancing work and family, and obtaining the necessary education (Paoloni, 2011; Mustapha, 2016; Cesaroni and Stentuti, 2015).

As mentioned, access to credit and financing could be difficult for female entrepreneurs (Moro *et al*., 2017) and, nowadays, it has become a topic of great interest in studies on female entrepreneurship, showing significant differences between male and female businesses (Paoloni, 2011; Cesaroni and Stentuti, 2015).

In particular, female entrepreneurs start their businesses with lower initial capital and even in subsequent phases, they mainly resort to personal, family and friendly resources rather than bank loans (Cesaroni and Stentuti, 2015; Paoloni, 2021). Despite numerous studies, the causes of these differences have yet to be clearly and definitively identified and are attributed to factors such as the structure of businesses, the decision-making processes of banks and the behaviours of female entrepreneurs. Looking at the business structure, Cesaroni and Sentuti (2016) found that female-run firms tend to be smaller and younger than their male-run counterparts, which usually require less capital. Considering female behaviours, Rita *et al*. (2018) have observed that gender stereotypes lead to differences in male and female behaviour, with males being more inclined to take risks and be aggressive, while females tend to be more empathetic and prefer stability. Heilman (2001) has shown that these personal traits manifest in how they manage businesses, as women are more averse to risk. As for the causes related to bank choices, it is not a discriminatory attitude per se, but rather a mistrust of the female firms because they are small and generally have fewer guarantees (Cesaroni and Stentuti, 2015).

However, the situation is changing. Thanks to the attention paid to female entrepreneurship by the UN in its 2030 Agenda, governments are now trying to support these realities, which are seen as one of the ways to achieve gender equality. For this reason, even the investments foreseen in the National Recovery and Resilience Plan (NRRP) pay attention to this theme. Mission 5 plays a fundamental role in pursuing the other objectives, transversal to the entire NRRP, concerning supporting female empowerment and promoting women's economic independence.

But how does this growing support of institutions for female entrepreneurship translate? Banks are adapting to this demand from institutions and increasingly

organise initiatives to support female entrepreneurship[1]. This gives rise to an issue related to the credit quality of women's enterprises.

From the literature review, it emerges that there is not a clear correlation between the gender of the entrepreneur and the quality of credit.

Several studies argued that females are less likely to default on their loan payments compared to male borrowers (Cheston and Kuhn, 2002; D'Espallier *et al*., 2009). In addition, women-run businesses are less likely to go into default, being less risky (De Andrés *et al*., 2021). Other reasons for women to have less probability of default are related to the fact that they are more inclined not to take risks and not to misappropriate resources provided by third parties in order to combat the stigma that exists in the comparison of women's credit (Garikipati, 2008).

However, other studies have found no particular correlation between credit quality and gender. In particular, several studies found a non-significant relationship between the gender of the borrower and the probability of not repaying the credit (Anthony and Horne, 2003, Godquin, 2004, Adusei and Appiah, 2011).

Nevertheless, the evidence on this point needs to be more conclusive, even though part of literature suggests that credits given to female enterprises perform better than those given to male enterprises. Therefore, it is interesting to see if this aspect is ever considered when talking about NPLs.

3 Research design

3.1 Historical and regulatory contextualization of the European and Italian NPL market

As mentioned, the phenomenon of NPLs has attracted the attention of the economic system since the financial crisis of 2007, when due to the worsening of the real economy, the solvency of debtors decreased, resulting in the accumulation of NPLs and the progressive deterioration of bank balance sheets. This liquidity crisis has triggered a vicious circle characterized by the increase in credit risk, legal and administrative cost of the loan, the decrease in interest income and related profits, as well as the request by supervision for a growing

[1] *Without going into detail, support for women's enterprises has been given by all the major Italian banks (e.g. Intesa San Paolo, Unicredit, Banco BPM, Banca Ifis, etc.), which currently have several specific financing activities in place.*

prudential amount of capital. Institutions and supervisory authorities initially intervened by injecting public resources into the system to restore the credit institutions' ability to raise funds. They operated by subscribing to capital increases and/or providing government guarantees on the liabilities issued.

This determined an acceleration of the regulatory adoption process in order to harmonize the European regulatory context of the classification and management of NPLs, still fragmented among the various Member States, within the attempt to create an homogeneous secondary market capable of supporting the real economy, dealing with the endemic deficiencies of the system.

Within this context, the European Banking Authority, in July 2014 published the document "Final draft Implementing Technical Standards (ITS) on Supervisory reporting on forbearance and non-performing exposure under article 99(4) of Regulation (EU) No 575/2013", adopted by the European Commission with EU Regulation no. 227/2015 on 9 January 2015, which amended the EU Implementing Regulation no. 680/2014 (implemented at the Italian national level with the seventh update of 20 January 2015 of circular no. 272 of 30 July 2008 by the Bank of Italy). This regulation aimed at introducing a harmonization of the definition of NPLs, still in force today, as well as the different methods of assessing and reporting loans.

In light of the effects of the financial crisis and after the emergency period, the European Commission has adopted the so-called *macro-prudential supervisory* approach by defining in the "Communication on the banking sector" more stringent criteria for the granting and use of public money to rescue the banking system to encourage greater involvement of resources directly by private individuals and bank stakeholders. Moreover, it assigns a central role to diminishing the stock and mitigating future accumulation of NPLs.

Furthermore, since 2017, the European Central Bank has drawn up the "Guidelines for banks on non-performing loans" and subsequent annual "Addendum" updates, which, without replacing supranational or national standardization, provide a common framework for credit institutions and best practices on the subject management of NPLs, clarifying the supervisory expectations on prudential provisions. Furthermore, since March 2017, national credit institutes have been called to highlight their commitments to dispose of non-performing assets in the short and medium term.

The EU Council and the European Commission also intervened in 2017 with the same aims, respectively approving an "Action plan to reduce the onset of non-

performing loans in the banking sector" and a "Package of measures for a more speed of NPLs in the banking sector", calling for greater banking supervision, further development of secondary markets and the restructuring of banking sector. As a result, EU Regulation 630/2019 was adopted in April 2019, amending the s.c. Capital Requirements Regulation, CRR 575/2013, by establishing a prudential limit on the accumulation of NPLs by banks, integrated with supervisory expectations on the matter, the Calendar Provisioning.

Subsequently, to ascertain the effects of Covid, the EBA adopted the document "Guidelines on legislative and non-legislative moratoriums on loan payments applied in the light of the Covid-19 crisis", allowing credit institutions to freeze own credit exposures and postpone the identification of non-performing assets. Subsequently, the European Parliament and the Council adopted Regulation (EU) 2017/2402, amended by Regulation (EU) 2021/557, which establishes a general framework for securitizations to support the recovery from COVID.

Regarding instead the Italian context, it is helpful to note how the financial crisis manifested itself more slowly and less severely than in the other northern European markets, due to the lower presence on the balance sheets of national banks of securities linked to the US real estate market. However, the structure of the domestic market based on a more traditional business model and a more stable supervisory and collection system, was not enough to counter the effects of the 2008 and 2013 recessions. The reason lies in the typical composition of the productive national system, made up mainly of Small and Medium Enterprises, in whose activities it is concentrated most of the credit disbursed by the banking system.

This delay in the national effects, compared to the European counterparts, has ended up limiting the capacity for intervention of the national government, since in the meantime, the approach of the European Commission, first with the Communication of 2013 and, then, with the adoption of the Directive 2014/59/EU, the Bank Recovery and Resolution Directive (BRRD), had already been changed and became more stringent. Therefore, having set aside the possibility of using alternative bailout instruments or of being able to establish a national bad bank, the government in 2016 opted to speed up the bankruptcy procedures related to NPLs and to establish the "Guarantee on the securitization of bad debts" (GACS) (decree-law 14 February 2016, n.18). This instrument, in compliance with state aid regulations, is based on the granting of a public guarantee on the senior tranches of securities, relating to NPLs. In addition, since 2016, a pool of banks and

institutional investors have set up specific private investment funds aimed at investing in the recapitalization of some banks and the purchase of the related NPLs at a price higher than the market average.

The national context is characterized by the presence of a significant pricing gap between supply and demand for NPLs and, therefore, between the price at which investors are willing to acquire NPLs on the secondary market and the book value of non-performing assets required by banks. This gap originates in the different techniques of recording credits and related costs adopted by banks and investors with negative effects on the lengthening of the recovery times of the assets; aggravated by the cumbersome nature of the functioning of judicial and civil proceedings. As a result, Italy has a higher average permanence of NPLs in the balance sheets of credit institutions compared to other European countries and an extinction rate among the lowest in Europe.

For this reason, credit institutions are progressively adopting business models capable of combining: in-house recovery management (whit high fixed costs); outsourcing to intermediaries specialized in the recovery, servicers (higher verification costs but better performances and generation of liquidity by the bank); sales on the market which, however, as anticipated, envisage a lower recovery capacity.

From a regulatory point of view, the national legislation on NPLs is based on art. 58 of the Consolidated Banking Act, legislative decree n. 385/1993 and on the law on credit securitization n. 130/1999. Recently, with the Legislative Decree no. 34/2019, Legislative Decree no. 50/2017 and the 2019 Budget Law the Government introduced simplification measures on the transactions of non-performing loans, as well the definition of possible new forms of financing of SMEs by the SPVs. Furthermore, the Bank of Italy, as supervisory authority, has been publishing and updating its guidelines on the sector since 2018, requiring credit institutions to adopt more rigorous approaches and strategies to optimize the management of NPLs and prevent future accumulation.

Also in Italy, the impact of Covid has further aggravated the deterioration rate of loans, lengthening the times of legal proceedings and the period of permanence of NPLs in the balance sheets. In this regard, the national Government had imagined the definition of the GLAM (Guaranteed Loans Active Management) platform, structured by AMCO, the Ministry's Asset Management Company, based on the transfer to specialized operators of a part of the vast portfolio of NPLs, which in Italy has reached 300 billion.

However, as the picture is still uncertain, it can be positive to investigate the introduction of new criteria for a better assessment of creditworthiness that can be applied within the evaluation of non-performing status. For this reason, the present work intends to analyze the use of the gender parameter, understand whether it is used in the NPL portfolio evaluation phase. Given that, as anticipated, women's credit presents a lower risk of default and greater reliability even in the event of deterioration, it would seem to have all the connotations to be included among the actual evaluation principles.

3.2 Methodology

The present analysis consists of a inductive content analysis of documents found online that deal with the topic of NPLs (Elo and Kyngäs, 2008). Specifically, content analysis is a process for analyzing written, spoken, or visual content to identify patterns, trends, and themes within the content. It relies on the systematic coding of textual information into categories and the tabulating of the frequency of each coded category (Krippendorff, 2018). This analysis can be considered inductive, as the categories used to classify NPLs were formed after reading the documents, abstracting from the particular to the general (Elo and Kyngäs, 2008).

The documents were found online and classified according to the issuer.

- International institutions;
- International supervisory authorities;
- National institutions;
- National supervisory authorities;
- Banking groups/servicers;
- Others

The search for information was conducted mainly online using the two main search engines: Google and Yahoo. The use of these two engines is justified by the fact that there is authoritative literature (Hewson *et al*., 2003), which considers observation studies conducted online, as satisfying the criteria of reliability and validity necessary for the robustness of a research method.

After the search, 30 main documents were included in the analysis sample. These documents include laws, reports and commentary on NPLs.

For each document, the content was examined (Elo and Kyngäs, 2008), focusing on the segmentation methodologies of NPL portfolios to understand whether

gender was an element taken into account by the actors dealing with this issue. Therefore, firstly, it was verified whether the topic of segmentation of NPLs was addressed in the document. If it was dealt with, the various criteria identified were analysed, with a particular focus on gender.

The output of this analysis concerns tables and figures typical of descriptive statistics.

4 Findings and discussion

In this paragraph, findings of the content analysis are illustrated and discussed. Before going into the details of the analysis, a preliminary result is shown related to sample composition is presented in table 1.

Table 1. Sample description

Type of organization	N° of documents
International institutions;	10
International supervisory authorities;	5
National institutions;	3
National supervisory authorities;	4
Banking groups/servicers;	2
Others	6
Total	**30**

Source: Authors' elaboration

This table shows that much of the documentation (15 out of 30) on NPLs comes from international actors (institutions or supervisory authorities). This is because the topic is relevant at the European level, as Europe has a banking union. Interesting how other actors (consulting firms mostly) are strongly active on the topic (6 documents out of 30).

Going into the selected documents, it can be seen that 19 out of 30 have a focus on segmentation issues. Table 2 shows the above-mentioned classification by the type of organizations that issue the document.

Table 2. Documents with and without references to NPLs segmentation

Type of organization	References to segmentation criteria	No references to segmentation criteria
International institutions;	6	4
International supervisory authorities;	3	2
National institutions;	0	3
National supervisory authorities;	4	0
Banking groups/servicers;	1	1
Others	5	1
Total	**19**	**11**

Source: Authors' elaboration

Many of the documents relating to these aspects derive from supervisory authorities (7 out of 19) or from others, mainly consulting firms (5 out of 19).

From the analysis carried out, it is possible to identify macro-classes of elements: the type of loan, borrower characteristics and collateral characteristics. Table 3 illustrates how many documents, among the 19 that refers to segmentation criteria, take into account each category.

In the loan type, it is possible to find both classifications based on maturity of the loans and classifications based on destination (typical of IFRS9). These types of classifications have a particular impact on the methods of accounting in the financial statements. In addition, the main segmentation about the loan type is related to the presence or the absence of security.

Table 3. NPLs macro-categories of classification

Type of organization	Loan Type	Borrower characteristics	Collateral characteristics
International institutions;	6	2	1
International supervisory authorities;	2	3	1
National institutions;	0	0	0
National supervisory authorities;	3	4	0
Banking groups/servicers;	1	0	0
Others	4	4	2
Total	**16**	**13**	**4**

Source: Authors' elaboration

With regard to borrower characteristics, the analysis of the documentation shows a more alternative choice. Several documents (13 out of 19), refer to the

possibility of segmenting portfolios according to geographical origin or activity. Next, reference is made to company size, which also appears in the literature (e.g. Lubis *et al*., 2015) to be a discriminating element of creditworthiness.

Other elements regarding the borrower are the nature of the borrower and distinguishing between corporate and individual entrepreneur/person. Among the criteria of this type, were mentioned age but also gender (1 document of the National authorities).

Finally, it is possible to focus on a particular category of claims, namely those backed by collateral. In particular, it is possible to subdivide these credits on the basis of the nature of the guarantee provided. A first macro-subdivision is made based on whether or not a public guarantee is held. For example, in Italy, there has been the GACS[1] scheme. Other subdivisions relate specifically to the type of collateral, whether real or personal. Collateral, normally preferred by the market, is in turn segmented according to the type of underlying property or the location of the property.

5 Conclusions

When NPLs are making a comeback, and markets are questioning the best ways to manage them, this paper enters this debate by addressing the issue of gender. As several studies have shown (Paoloni, 2011; Mustapha, 2016; Cesaroni and Stentuti, 2015), female-run businesses have specific characteristics. Since the efficient management of NPLs portfolios also derives from the ability of accurate segmentation, this study aims to understand whether gender could be a variable of interest.

Therefore, to answer the RQ: "Does gender somehow enter into the management of a bank's credits portfolio, and in particular into the management of non-performing loans (NPLs)?", an inductive content analysis (Elo and Kyngäs, 2008) was carried out on a sample of 30 documents from different organizations (authorities, institutions, banks, servicers, consultancies etc.).

The results of the content analysis show that, apart from a single document, gender is hardly ever taken into account as a criterion to segment portfolios.

[1] *GACS, which stands for Garanzia Cartolarizzazione delle Sofferenze, is the most impactful Italian measure supporting securitizations. It was initially approved by the European Commission, under the EU State aid rules, in February 2016 and extended in September 2017, August 2018, and March 2019.*

Although the market plays a fundamental role in freeing banking institutions from accumulating liabilities to make them better concentrate on providing credit, the organizations carry out their activity in a context of a supranational and national regulation that limits itself to define criteria and principles only on a general basis. Market operators refine the portfolio evaluation criteria by following a "self-assessment" approach, based on the evolution of their know-how and expertise acquired while managing portfolio transactions, without facilitating market transparency and efficiency. Along these lines, the classifications found in the documents are often broad (presence or absence of collateral, geographical location, business sector). However, more detailed categories could be pushed at the level of institutions and authorities as they align with new market needs (e.g. the numerous funding and support initiatives for female entrepreneurship in recent years).

This article has both practical and theoretical implications. From a theoretical point of view, it introduces the issue of gender in the segmentation criteria of NPLs' portfolios, opening a new strand of gender studies in this specific and technical topic. From a practical point of view, it could suggest authorities and institutions formulate more detailed criteria that follow today's market trends (e.g. the increase in supports for female entrepreneurs).

This work has limitations concerning the selected sample, as the documents only represent what was found online discussing NPLs. A broadening of the sample would allow the results to be expanded. In addition, future studies may concern the analysis of packages of NPLs from a gender perspective to observe the application of this criterion to segmentation

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Towards a Heritage Digital Guidelines in Planned Preventive Maintenance (PPM)

Graziella Bernardo*

Department of European and Mediterranean Cultures:
Architecture, Environment and Cultural Heritage
University of Basilicata
Via Lanera, 20 - 75100 Matera (Italy)

Cristina Rinaldi

Department of European and Mediterranean Cultures:
Architecture, Environment and Cultural Heritage
University of Basilicata
Via Lanera, 20 - 75100 Matera (Italy)

Antonella Guida

Department of European and Mediterranean Cultures:
Architecture, Environment and Cultural Heritage
University of Basilicata
Via Lanera, 20 - 75100 Matera (Italy)

** Corresponding author*

Abstract

The requirements of building sustainability and the use of information technologies have led to the new vision of continuum building design that considers each stage of a building's life cycle, including the recovery and up-cycling of materials and building components according to the circular economy models. Continuum building design promotes planned preventive maintenance (PPM) and moves away from the current emergency acting on assets compromised by serious pathologies. It allows the optimisation of time and resources and the durability of interventions through sustainable and effective practices. The paper presents the preliminary results of a research activity aimed at identifying and validating guidelines for architectural heritage conservation through the development of an open knowledge platform to dissemination of the best practices currently available. The main goals are promoting preventive and planned maintenance as the main strategy of conservation of the building heritage and overcoming the fragmentation and scarcity of reliable information of scientific and technical literature for diagnostics, interventions and durability monitoring. The guidelines will cover all stages

of the conservation process, from the preliminary phase of knowledge of the building. Moreover, type, extent and cause of degradation will be identified, including their resolution or at least their decrease according to the criterion of minimum intervention and maximum effectiveness with the lowest cost and the lowest environmental impact using sustainable and compatible products. The guidelines of the open digital platform will be identified through the study and critical analysis of interventions on monuments belonging to Italian historical heritage. The monuments chosen as case studies have been affected by various forms of degradation, in many cases triggered by the presence of rising damp. This latter one has been stopped using an already verified economical and sustainable device that uses charge neutralization technology CNT-Domodry®. The research provides for the initial activity of identification of digital standardization protocol, information cataloguing and metadata in order to achieve the final comparison of interventions and the consequent identification of best practices. The cataloguing rules of the ICCD and the digital platform for risk assessment of heritage of the ICR have been taken as a reference. Future developments of the research project will consist in the acquisition and critical processing of information on relevant number of case studies in order to have scientific evidence to proceed toward a Heritage Digital Guidelines in PPM.

Keywords – Building heritage, Conservation sustainability, Best practices, Cataloguing Information and Metadata, Open knowledge platform

Paper type – Academic Research Paper

1 Introduction

The new approach of continuum building design has increased the focus on the durability and sustainability of each phase of a building's life cycle (from its design to its dismantlement) and has oriented building's design and planned preventive maintenance (PPM) to the digital world with the aim of extending the architectural heritage life and preserving its memory through the optimization of time and resources required (Hong T. et al., 2020; Jin R. et al., 2019).

The central role of building life cycle management in the environmental, economic and social dynamics is now well known. In particular, the operation and maintenance phases represent 75-80% of the total resources needed during the entire life cycle of a building (Hauashdh A. et al., 2022). For this reason, in order to preserve and safeguard the cultural heritage, it is essential to pay attention to this stage by adopting a preventive approach to conservation to reduce the risk of loss of value and material of the architectural heritage and to optimize time and resources needed for the restoration interventions. It is in this perspective that the

building's design and planned and preventive maintenance (PPM) are oriented towards digital and IT tools (Hong T. et al., 2020; Jin R. et al., 2019).

The development of technology and information systems is increasingly influencing the world of architecture, especially in the design and construction of new buildings. (Hong T. et al., 2020; Llatas C. et al., 2020)

Several studies and scientific works have demonstrated the strong positive impact that technological and IT innovations are bringing in the building design process, but these same studies have shown that the application of information technology tools is limited to specific phases of building life cycle that mainly concern the spaces' design from scratch, plant design and cost analysis (Hong T. et al., 2020; Llatas C. et al., 2020).

However, there are no documented cases of the use of this tools to support the entire building life cycle, while there are few cases related to restoration and planned and preventive maintenance.

Because of the potential linked to the ability to perform predictive analysis and collect a large amount of information, the use of IT tools is extending to all phases of the building's life (Hong T. et al., 2020; Llatas C. et al., 2020). The information and design process' digitization has triggered a change in the methodological approach to the architectural heritage restoration project, enabling the optimization of the time and resources required for the buildings' conservation and preservation (AA.VV., 2021; Accardo G. et al., 2005; Lubelli B. et al., 2018).

2 Information technologies tools for architectural design

Since the construction is a complex activity composed of several multidisciplinary process, the need to optimize the building's construction process to improve its management and performance and to limit the risk of problems that might arise during construction and throughout the entire building's life cycle, have turned the attention of the architectural world to IT and technological innovations. (Hong T. et al., 2020; Jin R. et al., 2019; Nikmehr B. et al., 2021)

Among the most popular digital technologies are those related to the three-dimensional representation of buildings and the survey of architectural heritage; the use of laser scanners, total stations, Unmanned Aircraft System (UAS), digital

photogrammetry and modelling software have simplified and speeded up task of graphing, allowing greater control in design processes.

Information technology tools that support all those involved in decision-making's architectural project have also become popular because of their ability to simulate the end results of a building process. More and more skilled technicians are taking advantage of computer technology to organize construction sites, design systems, collect and store documentation and devise new forms (parametric architecture). (Hong T. et al., 2020; Jin R. et al., 2019; Llatas C. et al., 2020)

In the construction industry, the greatest benefits have come with the introduction of Building Information Modelling (BIM), which has enabled the digitalization of all phases of the building life cycle by incorporating the time dimension into the project. Thanks to this variant BIM can simulate the entire process and allows the preliminary identification of possible problems (construction defects, energy performance, conflicts between workings…) and the definition of the best possible solutions with immediate benefits on the sustainability of the construction process and the success of the interventions. (Cursi S. et al., 2022; Hauashdh A. et al., 2022; Hong T. et al., 2020; Nikmehr B. et al., 2021)

A concrete example of the potential of BIM in the construction sector is the recent work carried out by Studio Berlucchi s.r.l., an engineering company based in Brescia, which carried out the entire restoration of the Polirone Monastic Complex in San Benedetto Po (MN, Italy) by relying completely on BIM and producing a detailed 3D model of the complex with all the information collected. (Al-Muqdadi F. et al., 2023; Banfi F., 2021; Belmondo S., 2018)

In addition to BIM, other useful tools for predictive diagnostic of building's damages and performance are modern smart technologies: AMI - Advanced Metering Infrastructure, IoT - Internet of Things, AI - Artificial Intelligence, DSS - Decision Support System, ML - Machine Learning. (Hong T. et al., 2020; Llatas C. et al., 2020; Nikmehr B. et al., 2021)

These tools, with the help of appropriate sensors, devices and equipment, even allow real-time data collection (e.g. IAQ - Indoor Air Quality, indoor environmental quality) and taking advantage of big data progresses, powerful computing and artificial intelligence can produce a digital twin of the building optimizing its performance throughout its life cycle. (Hauashdh A. et al., 2022; Hong T. et al., 2020; Nikmehr B. et al., 2021)

2.1 Interoperability between tools and their limitations

The many different types of information needed for architectural design have led to the continued implementation of digital technologies to increase interoperability between tools and to provide more performance in the design simulations. (Cursi S. et al., 2022; Hauashdh A. et al., 2020)

Interoperability between tools defined by the ISO/IEC 2382 as the "capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units" allows a multidisciplinary approach to architectural design by combining the functions of different IT tools.

Starting from the BIM, which using the IFC (Industry Foundation Classes) format lends itself well to the easy transfer of data between one system and another (Cursi S. et al., 2022), plugins have been developed to allow the collection of different types of information (3D model, materials and construction techniques, temporal data, construction site documentation…) in a single platform through the integration of the BIM software with additional IT tools (GIS - Geographic Information System, graphic software, database, CDE - Common Data Environment…). (Cursi S. et al., 2022; Hauashdh A. et al., 2022; Yang X. et al., 2020)

Several experiments have demonstrated the effectiveness of interoperability between computer tools and software in the management of construction processes, but the coexistence of different types of data that are not always compatible is the major obstacle due to the partial or total loss of information during file transfer or to the difficulty in comparing data.

Additional application limitations of computer systems mostly refer to the field of restoration and maintenance of architectural heritage. The main difficulty in digitizing a detailed restoration project lies in the management of a huge amount of data of different nature that, through critical analysis, must lead to the definition of the best preventive and planned maintenance actions to preserve the memory of the building heritage.

However, the application of BIM and Heritage BIM (H-BIM) in maintenance operations is still developing and is based on more theoretical than practical approaches. This is because of the existence of little digital documentation for existing architectural assets, which has been acquired through different modes and tools that do not allow homogeneous data collection and make the data comparison and transfer operations difficult. (Cursi S. et al., 2022; Hauashdh A. et

al., 2022; Hong T. et al., 2020; Llatas C. et al., 2020; Lubelli B. et al., 2018; Nikmehr B. et al., 2021; Yang X. et al., 2020)

To overcome this problem, the research and the method and/or procedures of analysis should be systematized to obtain comparable results that allow the interaction between the data and their digitization (Shvaiko P. et al., 2013).

3 Tools for architectural heritage's conservation

As well as in the construction of a new building it is essential to assess its energy performance and construction phases beforehand to avoid wasting time and resources, in the same way it is important to make preliminary assessments for architectural heritage restoration and maintenance work using the tools currently available (Cursi S. et al., 2022; Hong T. et al., 2020; Jin R. et al., 2019; Llatas C. et al., 2020).

Since restoration and preventive and planned maintenance interventions involve a wide range of professionals with different skills, each of them must be up to date on research innovations and must be able to easily find all the information needed to intervene on the architectural heritage.

Various experiments have attempted to develop information systems and tools that could facilitate the decision-making process of professionals involved in architectural heritage conservation.

Among these experiences it is worth mentioning the Risk Map developed by the Italian "Istituto Superiore per la Conservazione ed il Restauro" (ISCR), which aims to provide information on the state of conservation of architectural assets and their factors levels of vulnerability and risk (distinguished into "individual vulnerability" and "territorial danger"). This tool is configured as a Geographical Information System associated with a special database in which each asset is catalogued by means of sheets, distinguished by categories of assets, which collect information regarding the state of conservation and the registry of the architectural asset (type, intended use, location, age of construction...). (AA.VV., 2013; Beni Culturali, Carta del Rischio)

A similar project is the one developed within the Interdisciplinary Research Program "Venezia 2021," which aims to provide indicators and descriptors useful for the assessment of the vulnerability of the built heritage in order to enable the definition of a restoration project that moves toward a preventive approach to ensure the preservation of the assets in the long period. (AA.VV., 2021)

In addition, the experience conducted within the inter-university research program "SCN_00520 Product and process innovation for sustainable and planned maintenance, conservation and restoration of the cultural heritage MIUR Smart Cities and Communities and Social Innovation" (Bernardo G. et al., 2021; Guida A. et al., 2018; IES) developed the digital platform HeMaIn (Heritage Maintenance Innovation) for the management of the maintenance process in collaboration with the IT company "TAB Consulting".

3.1 Toward an open knowledge platform tool for architectural heritage conservation

In light of the needs emerged from the study of the research state of the art to preserve and safeguard the architectural heritage's life, this research activity aims to contribute to the development of innovative tools and methods for preventive and planned maintenance for the preservation of architectural and cultural heritage: intervene on the preservation of architectural heritage also affects the preservation of the movable property stored in (Acordon A., 2013; Lucchi E., 2018; Rossi M., 1982). In particular, the work aims to contribute to the development of operational protocols based on currently available best practices for the restoration of buildings affected by capillary rising damp, a phenomenon that causes different kinds of deterioration in architectural artifacts of historical and artistic interest (Castelluccio R. et al., 2019; Franzoni E., 2014; Lubelli B. et al., 2018; Rossetto M., 2013).

It has become clear how the proper management of the complex preliminary phase of knowledge of the building has an important impact on the definition of the restoration project and its effectiveness and durability; therefore, through the critical analysis of the restoration interventions carried out on case studies in which CNT® (Charge Neutralization Technology)-Domodry® was applied, that is currently the most effective method for the resolution of rising damp (AA.VV., 2020; Castelluccio R. et al., 2019). The research methodology adopts a multidisciplinary approach and includes the analysis of the entire restoration process of the architectural heritage: historical/archival survey, material/constructive survey, pathological survey, planning and diagnosis of interventions and planning of preventive maintenance phases.

In order to preserve and safeguard the architectural heritage's life it is essential to set up a management and maintenance plan for the restoration and recovery

process that, in accordance with the restoration principles and the sustainability demands (environmental, economic, and social) identifies every action, procedure, and material needed for the definition of the restoration project, which must arrive at the determination of interventions and their verification of effectiveness to ensure the durability of the obtained results. For this reason, it is essential to combine a suitable restoration project with a diagnostic and monitoring plan to verify the state of conservation before and after intervention (AA.VV., 2020), relying on an open knowledge platform tool that simplifies and speeds up the design process and continuous updating on current innovations.

Another challenge related to the development of an open knowledge platform tool lies in the certification and traceability of information uploaded and reprocessed by different stakeholders (Eppinger E. et al., 2021; Murray-Rust P., 2008). For this purpose, many IT tools have already been equipped with systems that allow visualization of the source and author of the data and guarantee the intellectual property of the same. An example is "Blockchain" technology, which makes possible the development of applications where different parties can enter information into an open and implementable database without needing a central control and verification entity (Cursi S. et al., 2022; Nikmehr B. et al., 2021).

The scientific literature and the research state of the art, regarding the restoration of buildings affected by rising damp, offer few and inconclusive information that are difficult to compare (Lubelli B. et al, 2018); for this reason, the research aims to bring together all the information and results obtained in a digital platform, configured as an open knowledge platform tool, which has the dual objective of making information accessible to support the preventive maintenance's processes of the architectural heritage and to act as an incubator of innovations for overcoming the limitations of currently available materials and technologies.

As a matter of fact, there is still no open and implementable digital platform that allows in a single database a critical overview of the existing tools, methods, processes and materials to support the development of preventive and planned maintenance and to plan all the phases of a restoration project.

4 The digital cataloguing of information

In order to identify all the "Best Practices" useful to define a restoration process, it is essential to compare and analyse in detail numerous case studies.

Therefore, it is necessary to define from the beginning how to collect and catalog information for an orderly work that can also support future experiences.

To develop the open knowledge platform tool, it was decided to start with the setting up of a "model sheet" that would provide clear and shareable indications on how the information should be found and how the data should be organized to ensure homogeneity and comparison of the same.

A survey of current cataloguing methods, forms, protocols and guidelines developed from experience was conducted. Specifically, two cases were selected for the development of this specific research activity.

A first case is the "Catalographic Standards" of the ICCD (Central Institute for Catalog and Documentation). (ICCD; Tucci R., 2018) These standards aim to simplify the acquisition of knowledge about the archaeological, architectural, landscape, historical, artistic and demo-ethno-anthropological heritage through the introduction of special tools and rules that allow homogeneous cataloguing in the Italian territory.

Catalogued data are entered into a General Catalog Information System (SIGECweb) that manages the entire flow of of information. This web-based platform is accessible only to registered and associated users who can perform certain activities depending on the user profile with which they have been associated with the system: administrator, cataloguer, verifier, reading user and consultation user.

A second case is represented by the information system developed by the Central Institute for Restoration (ICR) with the aim of providing scientific and administrative support to the institutions responsible for the protection of cultural heritage (Accardo G. et al., 2005; Cultural Heritage).

This information system consists of a Geographical Information System (GIS), which exploiting a statistical approach provides information on the state of preservation of assets and their risk and vulnerability factors. The platform, equipped with a system of databases, alphanumeric and cartographic, is implemented through the compilation of specific sheets available on the appropriate website.

These sheets are differentiated according to the area to be analysed (Environmental sheets, Historic centre sheets, Underwater sheets, Vulnerability - seismic sheets, Vulnerability - state of preservation sheets) and refer to the ICCD Catalographic Standards.

Based on these experiences, it was decided to create a new "Model Sheet'' that would meet the needs of this research activity and conform to the national catalographic system (ICCD) so that the information and results obtained can dialogue with SIGECweb.

Therefore, the rules provided by the ICCD were followed in the realization of the sheet, while for the information on the state of preservation of the architectural heritage, reference was made to the "Vulnerability Sheet - State of Preservation" created by the ICR.

The sheet, created with the support of the open software "Obsidian v.1.1.16" (which operates on Markdown files and allows the creation of internal links for better management and comparison of information), is divided into two macro-chapters: registered data of the architectural heritage, architectural heritage description.

To develop the chapter of architectural heritage's registerd data (Fig. 1), reference was made to what had already been developed by the ICCD's file on architectural heritage. Fields pertaining to the following aspects were included in this chapter: unique identification code, search level, subjects involved in the cataloguing, subject of the sheet, location, historical information, relationship with the context, legal status and constraints.

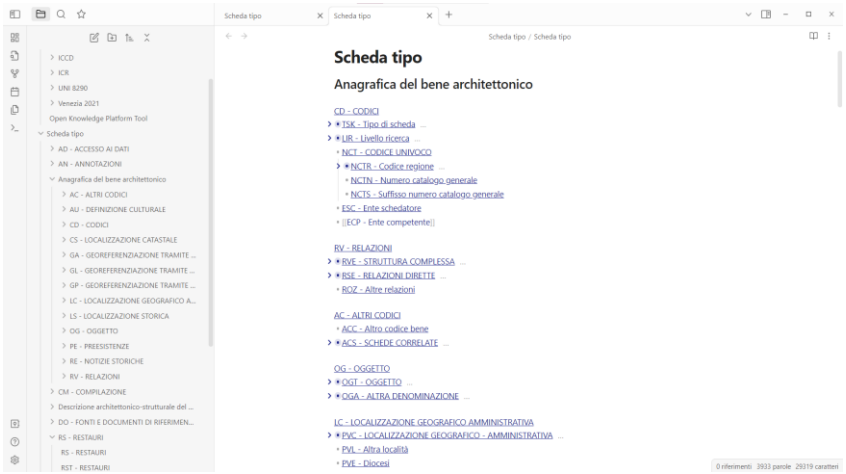

Fig. 1 Screenshot of the Model Sheet's "Architectural heritage's anagraphic data" section realized with Obsidian v.1.1.16 (authors' image)

For the chapter on architectural heritage description, we started by analysing what has already been done by the ICCD and ICR and came to the conclusion that both proposed sheets have a lack of information that have been filled by using the classification of the technological system introduced by UNI 8290.

The section about the architectural-structural description of the building (Fig. 2) was structured by decomposing the building system into the three information levels defined by the UNI 8290 (classes of technological units, technological units and classes of technical elements) to do not leave out any component of the architectural organism. For each class of technological unit, were included fields that specify the individual technological units and classes of technical elements analysed and provide information on the following aspects: type, location, construction technique, materials and inspect ability.



Fig. 2 Screenshot of the Model Sheet's "Architectural heritage's description" section realized with Obsidian v.1.1.16 (authors' image)

To better understand the state of conservation of every building's component an additional section (Fig. 3) has been integrated to each of them to add information about the conservation and the analysis of the existing phenomena of deterioration and alteration, inserting an additional focus on phenomena linked with the presence of moisture in the structure.

For the realization of this section, we started from the form provided by the ICR for the evaluation of the state of conservation of architectural heritage and integrated it with the classifications defined in the lexicon of the UNI 11182:2006 to standardize the data collected for future research developments.

This section allows the entry of information identifying the type of degradation or alteration, severity of degradation, percentage of spread, urgency and recommended interventions for the restoration of architectural elements.

A final section of the sheets wants to collect data and information regarding all restoration operations conducted on the architectural heritage and provides information regarding the types of interventions carried out, materials and techniques used. In addition, fields specifying the advantages and disadvantages resulting from each intervention should also be filled in.

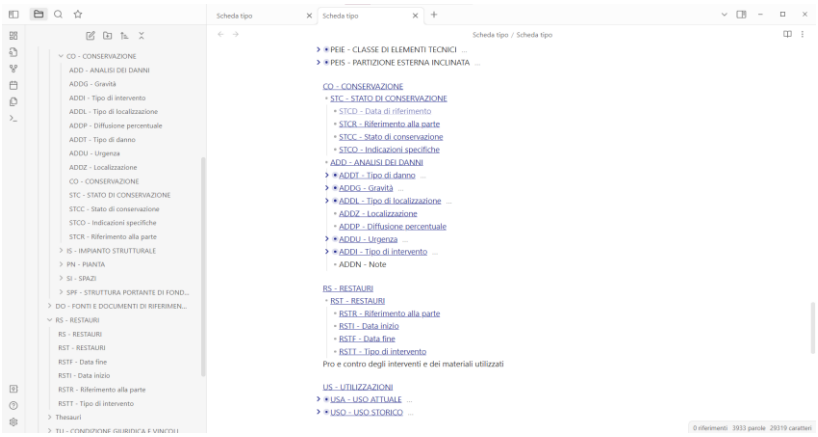

Fig. 3 Screenshot of the Model Sheet's "State of Conservation" and "Restoration" sections realized with Obsidian v.1.1.16 (authors' image)

5 Conclusions and future developments

The development of an open knowledge tool configured as an open and implementable platform will allow the organization of data and information for the identification of currently available "best practices" for the restoration of architectural heritage affected by the phenomenon of rising damp.

One of the goals of the open knowledge platform tool is to communicate with national cataloguing systems to permit the collection of as much information and experience as possible in order to constantly improve and update best practices for architectural heritage conservation.

For this reason, the platform could be managed with a blockchain system that allows anyone to increase the data available by opening new horizons for research and experimentation, as with SIGECweb. In this way it will be possible to

start a process of raising awareness among all stakeholders involved in the conservation of the architectural heritage.

Only by adopting a systematic and shared approach, based on the results of past experience and scientifically validated results, it is possible to move toward the definition of a standard of good restoration practices that takes into preventive and planned maintenance to support the decision-making process of all stakeholders involved in the heritage conservation process who will have at their disposal tools that will allow the optimization of time and resources for the benefit of the conservation process.

6 Author Contributions

Conceptualization, G.B. and A.G.; methodology, G.B.; resources, G.B. and A.G.; data curation, G.B.; writing and editing, C.R; review G.B. and C.R.; supervision, A.G. All authors have read and agreed to the published version of the manuscript.

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Applying Circular Economy to Buildings: An Open and Collaborative Innovation Case

Lucrezia Sgambaro*

Department of Management, Economics and Industrial Engineering
Politecnico di Milano
Piazza Leonardo da Vinci, 32, 20133, Milano, Italy

Davide Chiaroni

Department of Management, Economics and Industrial Engineering
Politecnico di Milano
Piazza Leonardo da Vinci, 32, 20133, Milano, Italy

Andrea Urbinati

School of Industrial Engineering
LIUC Università Cattaneo
Corso G. Matteotti, 22, 21053, Castellanza, Varese, Italy

** Corresponding author*

Abstract

Circular economy is an economy model aiming to overcome the current linear economy and closing resources loop. Circular economy is still far from being widely widespread and implemented. The transition to circular economy is particularly tough in complex and highly fragmented sectors where information, materials and products' flows are interrupted multiple times at different stages. Among these complex and fragmented sectors, the building sector stands out given its high resource consumption and emissions. Collaboration is needed to implementation circular economy in the building sector. Indeed, collaboration enables to spot in advance any issues and/or mismatches that may arise along the whole value chain given that the different actors belonging to the value chain jointly collaborate since the starting design phase. We have focused on buildings' façade, as they are responsible for 10% to 20% of the total embodied carbon emissions of the building and they are external elements easy to be accessed, maintained and assembled. The different actors involved in the façade value chain have been identified, through action research methodology. Besides, the collaboration among the actors involved, on the one side, in the circular product development (i.e. exploration phase) and, on the other side, in the circular business model design (i.e. exploitation phase) have been detected. We posit

that (i) collaboration is key in order not to have mismatches along the whole value chain and be able to exploit the potentialities of circular economy, (ii) different actors are involved in exploration and/or exploitation phase performing the same or different roles, depending on their specific skills and resources.

Keywords – Circular business model, circular buildings, collaborative innovation, open innovation, PSS

Paper type – Academic Research Paper

1 Introduction

The current mainstream economy model is based on the "take-make-dispose" paradigm, i.e. on resources extracted from natural environment, exploited for products' manufacturing and then disposed. The long term sustainability of this paradigm has been extensively debated (Biswas & Roy, 2015; Kristensen & Mosgaard, 2020; Murray, Skene, & Haynes, 2017) and more recently paved the way to an opposite paradigm, based on resources' value preservation and products' useful life extension (N. M. P. Bocken, de Pauw, Bakker, & van der Grinten, 2016; Geissdoerfer, Morioka, de Carvalho, & Evans, 2018; Kirchherr, Reike, & Hekkert, 2017; Merli, Preziosi, & Acampora, 2018), and named Circular Economy.

The transition from linear to circular economy is far from being completed, especially in sectors characterised by long value chain, high products' complexity, resource consumption and emissions (Leising, Quist, & Bocken, 2018).

Among these sectors, the building sector stands out as being responsible for 33% of emissions, 40% of resources consumption and 40% of waste production worldwide (Ness & Xing, 2017). Moreover, the building sector is characterised by a long and fragmented value chain and a high complexity and durability of its final products (i.e. buildings) (Dewagoda, Ng, & Chen, 2022). Therefore, implementing circular economy in the building sector is challenging and calls for an open and collaborative innovation approach (Giorgi et al., 2022; Khitous Fatima, Urbinati Andrea, Chiaroni Davide, 2022; Köhler, Sönnichsen, & Beske-Jansen, 2022). Indeed, it requires all the companies belonging to the whole value chain to engage themselves in the transition from linear to circular economy (Genovese, Acquaye, Figueroa, & Koh, 2017; Ghisellini, Cialani, & Ulgiati, 2016; Seuring & Müller, 2008).

Moreover, the transition from linear to circular requires the involved companies to redesign the whole business model dimensions, namely value creation, value transfer and value capture. Circular economy principles have to be adopted in the whole business model. Indeed, not only the product/service must be designed according to circular economy principles but also the created value has to be properly transferred and captured through ad hoc circular managerial practices (e.g. product-service-systems) (Centobelli, Cerchione, Chiaroni, Del Vecchio, & Urbinati, 2020; Urbinati, Chiaroni, & Chiesa, 2017). In the value creation phase, it is needed to shift from the design of a linear product to the design of a circular product (Centobelli et al., 2020). A circular product design in the building sector has to consider many different features during its life cycle (e.g. remanufacturing, reusability) and requires new actors to be involved in the innovation process (N. M. P. Bocken et al., 2016). Indeed, the whole value chain must be aligned and involved (Farooque, Zhang, Thürer, Qu, & Huisingh, 2019; Leising et al., 2018). An open and collaborative innovation approach might be, therefore, an enabler for the circular design by engaging external actors (Jesus & Jugend, 2023; Köhler et al., 2022).

After having jointly designed the final product according to circular economy principles, the companies belonging to the buildings' value chain should jointly develop the proper business model, through which deliver and capture the value created (Centobelli et al., 2020). To design a proper circular business model, many aspects have to be taken into account (e.g. take back systems, product-service-systems) (Centobelli et al., 2020; Lewandowski, 2016) and the whole value chain needs to be involved in the business model design (Farooque et al., 2019; Leising et al., 2018). Also in this case, an open and collaborative innovation approach could be applied To engage all the needed actors in a common effort toward a shared circular business model (N. Bocken & Ritala, 2022).

Current literature about circular economy in the building sector focuses on (i) designs strategies and/or tool for circular buildings (Antwi-Afari, Ng, & Chen, 2022; van Stijn & Gruis, 2020), (ii) the level of application of circular principles in the building sector (Giorgi et al., 2022), (iii) the circular strategies that could be applied in the buildings' sector (Charef, Lu, & Hall, 2022; Chen, Feng, & Garcia de Soto, 2022; Dewagoda et al., 2022) and (iv) Life Cycle Assessment analysis (Antwi-Afari et al., 2022). All these perspectives contribute to enlarge literature on circular economy and the building sector and to improve the understanding of the role of circular economy in the buildings context.

However, to the best of our knowledge, the interplay between circular economy, the building sector and open and collaborative innovation is still a promising and emerging research field with only a few recent contributions (Charef et al., 2022; Chen et al., 2022; Giorgi et al., 2022; Oluleye, Chan, Saka, & Olawumi, 2022). The application of open and collaborative innovation in the circular buildings' context merits additional academic research. Hence, we aim to contribute to extant literature by (i) defining the actors collaborating to jointly design innovative circular buildings' components and business models and (ii) the roles performed by these actors in value creation, transfer and capture dimensions. Our research question is therefore: which are the collaborating actors and the roles performed to jointly develop innovative circular products and business models?

The remainder of this paper is organised as follows. Section 2 deepens the state-of-the-art of both circular economy in the building sector and open and collaborative innovation. Section 3 presents the methodology applied in this research paper. Findings are presented in Section 4. Finally, Section 5 provides conclusions, limitations and future research avenues.

2 State-of-the-art

2.1 Circular Economy in the building sector

The conventional buildings construction industry follows a linear value chain and, given the complexity and specificity of this industry, materials and information flows are interrupted at each stage of the building value chain (Dewagoda et al., 2022; Giorgi et al., 2022). Consequently, long-term goals are rarely shared by the different players involved in the process resulting in an overestimation of materials used (Charef et al., 2022; Chen et al., 2022; Khitous Fatima, Urbinati Andrea, Chiaroni Davide, 2022). Given the impact of the building sector on the environment (as reported in Section 1), the building sector has been identified as a "priority area" for the transition to circular economy (Giorgi et al., 2022). Indeed, implementing circular economy in the building sector could reduce the usage of virgin material and emissions, by preserving resources' value and extending buildings' lifecycle (Ness & Xing, 2017).

Circular economy principles applied to buildings have been defined as "a lifecycle approach that optimizes the buildings' useful lifetime, integrating the

end-of-life phase in the design and uses new ownership models where materials are only temporarily stored in the building that acts as a material bank" (Leising et al., 2018).

However, the application of circular economy in the building sector is still not well developed in Italy as well as in other European countries (Giorgi et al., 2022).

External elements of a building are one of the most suitable for the implementation of circular economy principles in the building sector (Giovanardi et al., 2023; Hartwell, Macmillan, & Overend, 2021; Wouterszoon Jansen, van Stijn, Eberhardt, van Bortel, & Gruis, 2022). Indeed, among building's external elements, the building's façade stands out as being responsible for 10% to 20% of the total embodied carbon emissions of the building and the ease of access to such components facilitates maintenance, repair and disassembly operations, merging environmental, technical and business benefits (Giovanardi et al., 2023). This paper is therefore focused on buildings' façade, given their high environmental impact and ease of access, maintenance, repair, characteristics making façade one of the most suitable buildings' elements in which to implement circular economy principles.

The implementation of circular economy principles in the façade sector could be enabled by different circular managerial practices to be applied in the different circular business model dimensions. The first and fundamental dimension on which to act to design a circular business model is value creation. The main circular practice to implement circular economy principles in value creation refers to circular product design practices (N. M. P. Bocken et al., 2016; Centobelli et al., 2020; Sassanelli, Urbinati, Rosa, Chiaroni, & Terzi, 2020). The most relevant circular design practices, stemming from current literature, aim to extend product lifecycle and refer to (i) design for assembly/disassembly, (ii) design for modularity, (iii) design for prefabrication, (iv) design for standardization, (vii) design for accessibility, (viii) design for manufacture, (ix) design for reuse, (x) design for flexibility/adaptability (Charef et al., 2022; Chen et al., 2022; Eberhardt, Birkved, & Birgisdottir, 2022). These aforementioned design practices could entail the development of novel technologies and thus require a joint effort to benefit from the combination of the complementary skills and resources from the actors involved in the circular design process (N. M. P. Bocken et al., 2016). To transfer and capture the created value, ad hoc circular managerial practices could be implemented (Centobelli et al., 2020). The most relevant circular managerial practices, stemming out from current literature, aim to servitization strategies and

refer to (i) take-back systems (TBS), (ii) product-service-systems (PSS), (iii) traceability, (iv) sharing (Charef et al., 2022; Munaro, Freitas, Tavares, & Bragança, 2021). To effectively implement these circular design practices and circular managerial practices, the involvement and collaboration among the different actors of the façade value chain – and, eventually, new actors not nowadays part of the façade value chain – is key to convey circular economy principles all along the value chain, implement the servitization principle and thus circular economy (Charef et al., 2022; Eberhardt et al., 2022; Munaro et al., 2021).

2.2 Collaborative and open innovation in the Circular Economy

The transition from linear to circular economy calls for open innovation practices (N. Bocken & Ritala, 2022; Jesus & Jugend, 2023; Köhler et al., 2022). Indeed, open innovation practices are aligned with two key characteristics of the transition towards circular economy. On the one hand, open innovation leverages on external knowledge sources, not only internal ones, and these external knowledge sources are an important factor to implement circular economy practices (e.g. design for X) and manage to close resource loop, thanks to collaboration among different actors (Aarikka-Stenroos, Chiaroni, Kaipainen, & Urbinati, 2022; N. M. P. Bocken et al., 2016; Genovese et al., 2017; Ghisellini et al., 2016) . On the other hand, open innovation leverages on a value chain perspective, not only a company-focused perspective, and this value chain perspective is a paramount factor to be considered in implementing circular economy practices (e.g. product-service-systems) in order not to incur in mismatches among the different value chain's phases and products useful life's phases (Chen et al., 2022; Farooque et al., 2019; Khitous Fatima, Urbinati Andrea, Chiaroni Davide, 2022). Hence, open innovation could be an enabler of the transition from linear to circular economy by involving not only the focal company but also the whole supply chain in the transition toward circular economy and by proactively engage all the involved companies.

To maximize the value generated by open innovation, both exploration and exploitation activities must be taken into account. The former refers to an innovation development process enhanced by external knowledge sources, the latter refers to effectively capturing through the involvement of external actors the value created (Raisch & Birkinshaw, 2008; van de Vrande, de Jong, Vanhaverbeke, & de Rochemont, 2009). Both exploration and exploitation call for

collaboration, indeed there is the need to gather not only internal but also external knowledge sources, and for a value chain perspective in order not to have a too narrow focus (Lavie & Rosenkopf, 2005).

Thanks to open and collaborative innovation, companies can cooperate and jointly develop (i) the circular product design (through exploration activities) and (ii) a common and shared circular business model (through exploitation activities), in which value creation, value capture and value delivery are designed according to circular economy principles (N. M. P. Bocken et al., 2016; Centobelli et al., 2020; Urbinati et al., 2017).

We aim to understand if and how the actors involved in the circular product and business model design process have implemented open and collaborative activities (i.e. exploration and exploitation ones) in the transition from linear to circular economy.

3 Methodology

The empirical base for our research has been provided through an action research approach, i.e. "an approach to research that aims both at taking action and creating knowledge or theory about that action" (Coughlan & Coghlan, 2002). In action research, researcher and practitioners are actively involved in a real world research processes, from research design to evidences and findings identification, aiming to advance both academic and practical knowledge (Checkland & Holwell, 1998; Whyte, 1991). Action research methodology has already been applied in the building sector, enabling close collaboration between the building sector's' practitioners and researchers and advancing both theory and practice (see e.g. Eriksson, 2010).

This paper is based on the active participation of researchers, to the "Envelope for Service (E4S) - Phase II" project. "E4S – Phase II" is the sequel of "E4S – Phase I" research project.

Both Envelope for Service – Phase I and Envelope for Service – Phase II rely on multi-disciplinary collaboration of designers, planners, engineers, consultants, technical specialists and scholars, representing both industry partners and academic partners. The main objective of the "E4S – Phase II" project was to design a circular business model according to the servitization principle to be applied in the façade sector. Through the collaboration of both academic and

industry partners involved in the research project, it was possible to identify a circular business model proposing buildings' façade as product-service-system.

The paper's authors took actively part to the development of the "Envelope for Service (E4S) - Phase II" following each project advancement, participating to the project meetings and proactively contributing to the development of an innovative circular business model in the façade sector.

4 Envelope for Service project: overview and case study implementation

The Envelope for Service project aimed at:

i. Designing an innovative circular façade, considering the integration of circular economy design practices as early as possible in the product design phase,
ii. Defining a circular business model to offer the developed innovative circular façade by involving not only the single company offering the façade to the final users but also the whole façade value chain actors,
iii. Provide empirical evidence of the application of the Envelope for Service model in a real demo case in Italy.

As described in Section 3, both Envelope for Service – Phase I and Envelope for Service – Phase II rely on multi-disciplinary collaboration of both industry partners and academic partners. This collaborative and innovative environment enabled to identify (i) the different actors belonging to the façade value chain and (ii) the different roles performed by each actor in the design of the value creation, transfer and capture dimensions. Firstly, the key actors of the façade value chain were jointly identified by the project's partners in the following ones: integrated design consultancy company, façade manufacturer, service provider, facility manager, asset owner and final user. Each actor belonging to the façade value chain contributes in different ways to the exploration and the exploitation phase based on its specific skills and resources. For instance, the façade manufacturer contributes solely to value creation (i.e. the exploration phase), given its focus on façade's production activities. The façade value chain's actors and their roles in value creation, transfer and capture dimensions are discussed in Section 5.

The empirical evidence is based on a real word Italian testing project. This case study refers to the retrofitting of an existing building through the adoption of innovative façade modules. These modules are composed by controllable blinds,

a decentralized ventilation machine and a building integrated photovoltaic (BIPV) system. Moreover, the innovative façade modules are embedded with digital technologies that optimize daylight control, thermal heat transfer optimizing thus also energy consumption and comfort perceived by the buildings' occupants. Besides, the BIPV enables to produce electric energy and to, partly, self-consume it. The innovative façade design is modular and enables easy assembly and installation at the building premise easily adaptable to the specific building's characteristics. Considering the building's characteristic of the testing project, it is a residential social housing condominium, almost forty years old and located in central Italy, with four floors and more than ten flats. The application of the Envelope for Service concept, from a technology perspective, gives thus evidence of a promising innovative circular façade to be adopted in residential buildings generating both qualitative (i.e. improved comfort) and quantitative benefits (i.e. energy consumption reduction). Considering then the economic perspective, the investment cost of the innovative circular façade is higher than the investment cost of the traditional façade. The investment cost difference is relevant and the benefits achieved by reducing the energy consumption, and thus by reducing the energy bill, are not enough to counterbalance the investment cost differential, resulting in negative economic performance for the innovative circular façade.

5 Findings

As described in Section 2.1, the building façade is one of the most suitable buildings' elements for the implementation of circular economy principles in the building sector, given its environmental impact and ease of access, maintenance, repair (Giovanardi et al., 2023; Hartwell et al., 2021; Wouterszoon Jansen et al., 2022). Hence, this paper focuses on building façade from two different perspective (i) the value creation perspective (i.e. exploration phase) and (ii) the value transfer and capture perspective (i.e. exploitation phase), based on the evidence emerged in the "E4S – Phase II" project. The former is presented in Section 5.1 and the latter is presented in Section 5.2. For both perspectives, we report the actors involved in the collaborative process, the actors' roles and the circular practices applied by each actor. The evidence emerged from both perspectives are then gathered in a research framework presented in Section 5.3.

5.1 Value Creation (Exploration phase)

Table 1 gives evidence of the actors involved in the value creation dimension (i.e. exploration phase) by describing their role in the design process and the circular design practices applied.

Table 1 – Exploration phase: main actors involved

Actor	***Role***	***Circular design practices***
Service provider	It acts as the technical project manager, gathering and providing all the relevant information (e.g. product requirements' needed by the final user) to the proper actor involved in the technical activities (i.e. in the design phase)	Design for modularity, design for accessibility, design for reuse, design for flexibility/adaptability
Façade manufacturer	The involvement of the façade manufacturer in the design phase prevents the risk of a mismatch between the design, the manufacturing and the installation phases and leads the development of manufacturing activities according to "design for X" practices	Design for assembly/disassembly, design for modularity, design for prefabrication, design for standardization, design for accessibility, design for manufacture
Integrated design consultant	Integrated design consultancy company provides strategic guidance on the whole design process, enabling the early identification of issues and threats. Integrated design consultancy company has thus to consider the needs of the different value chain actors involved, the façade's requirements needed, for instance, by the final user and the circular economy practices to be followed to design a circular product	Design for assembly/disassembly, design for modularity, design for standardization, design for accessibility, design for reuse, design for flexibility/adaptability
Final user	Final users interact with the service provider, providing them the final product desiderata and requirements to be satisfied according to their needs	-

The service provider acts as the focal point, the technical project manager collecting external and internal knowledge sources supporting the development of the innovative product. The involvement, in the design phase, of both the façade manufacturer and the integrated design consultancy company enables to avoid mismatches among design, manufacturing and installation phase, reducing wastes and inefficiencies (in accordance with Charef et al., 2022; Eberhardt et al.,

2022). Finally, the final users have an active role in this design process by providing to the service provider the desired characteristics to be met by the innovative product.

All the circular design practices identified in literature (see Section 2.1) were applied by the involved actors even if in different ways. Indeed, the service provider focuses more on the circular design practices enabling to adapt the technology to be developed to the different actors' needs (e.g. design for flexibility/adaptability). Moreover, the façade manufacturer focuses on circular design practices enabling not to have mismatches among design, manufacturing and installation phases, thus focusing on e.g. design for assembly/disassembly, manufacture. Finally, integrated design consultant focuses on both circular design practices considering the different actors' needs (e.g. design for flexibility/adaptability) and avoiding mismatches among the different lifecycle phases (e.g. design for assembly/disassembly).

Thanks to the collaboration between the actors involved in the exploration phase, the innovative circular façade has been developed. The innovative circular façade modules are embedded with digital technologies, that deliver performance improvement and enable the digitalization of the whole value chain. The façade can thus work as a system, with façade modules including many functional products and services, that deliver a pre-determined and customized performance. The benefits of applying digital technologies in the building industry are also reported by e.g. Giovanardi et al., 2023.

5.2 Value Transfer and Capture (Exploitation phase)

Table 2 gives evidence of the actors involved in the value transfer and capture dimensions (i.e. exploitation phase), by describing their role in the business model and the circular managerial practices applied.

Table 2 – Exploitation phase: building's value chain actors involved

Actor	***Role***	***Circular managerial practices***
Service provider	The service provider retains the façade ownership along the whole lifecycle. Hence, the service provider is in charge of the maintenance and monitoring of the façade, in order to guarantee stable performances	Product-service-system

Integrated design consultant	Integrated design consultancy company supports the service provider in defining the KPIs to be monitored to guarantee the façade's performance	Traceability, product-service-system	
Facility manager	The facility manager acts in close collaboration with the service provider, supporting monitoring and maintenance activities and ensuring the adequacy of the façade's performances	Traceability	
Asset owner	The asset owner relies on the service provider, who has to ensure the agreed façade's performances	-	
Final user	Final users are in charge of the correct utilization of the final product, avoiding any misusage	-	

The service provider acts as a central player, the hub of the value chain, the customer's single point of contact.

The innovative features (e.g. modularity, digitalization) of the circular façade, make it suitable for the delivery of a Product-Service-System (PSS) package. PSS is one of the main managerial practices for value capture in circular business models (Centobelli et al., 2020). The implementation of PSS for capturing value from customers requires a close collaboration between producers and customers (Mendoza, Sharmina, Gallego-Schmid, Heyes, & Azapagic, 2017). Indeed, functionalities rather than ownership are delivered in PSS and consumers only own a license or a lease contract, moving from purchase to "pay-per-use" or "pay-per-performance" strategies (Centobelli et al., 2020). The PSS approach selection is aligned with what stems from the study by Charef et al. (2022), who posit PSS as an optimal solution for adaptability and flexibility to any changes, including changes occurring during the building's use phase, and overcome issues related to ownership changes.

Hence, the service provider retains ownership and responsibilities over these innovative circular façade systems during the whole lifecycle, enabling façade disassembly, refurbishment and reuse. The innovative circular façade modules should thus be offered through a one-stop-shop and performance-based model, leveraging on different partners, each providing specific competences. Integrated design consultancy company supports the service provider by defining the performance KPIs to be monitored. The facility manager collaborates with the

service provider supporting monitoring and maintenance activities and ensuring the adequacy of the façade's performances.

Apart from product-service-system, the other circular managerial practice applied in the exploitation phase refers to traceability, applied to track over time the performance achieved by the façade and give evidence of them to the final users. Performance tracking is also a key enabler for performance-based contract application, given the possibility to measure the achieved performance and compare them to the target performance to be achieved according to the performance-based contract (Yi, Lee, & Kim, 2017).

Finally, given the similarities between the skills required and the business model applied, Energy Service Companies (ESCo) have been identified as the proper service provider. Indeed, ESCo already have in their current business model, applied in the energy efficiency market, the key characteristic (i.e. performance-based contract offered leveraging technical and managerial partnership) needed in the circular economy market (Carbonara & Pellegrino, 2018; Huimin, Xinyue, & Mengyue, 2019; Yi et al., 2017).

5.3 A comprehensive picture of actors involved and roles performed

To gather the findings emerged, we developed an ad hoc framework summarizing the actors involved in the two phases and their roles. Figure 1 shows the actors involved in exploration and exploitation phases differentiating between actors with the same role in both phases and actors with different roles in the two phases.

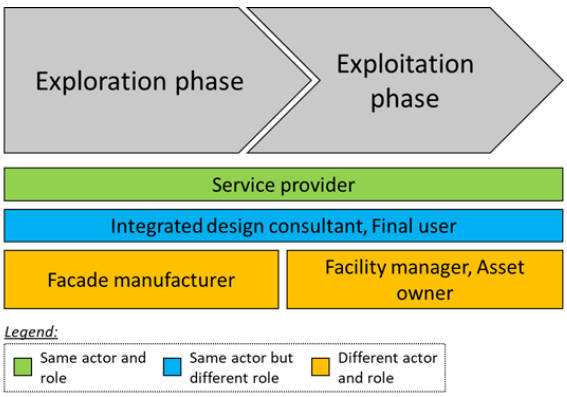

Figure 4 – Research framework: actors involved in the exploration and exploitation phases and their roles

The service provider, i.e. the ESCo, is the only actor which is involved in both phases performing the same role. Indeed, in both phases it is the single contact point for the final users performing project management activities (either from a technical perspective, in the exploration phase, or from a managerial perspective in the exploitation phase). Hence, the service provider emerges as the key actor enabling the offering of the innovative circular façade.

The integrated design consultant and the final users are involved in both phases but with different roles. The former acts in the exploration phase as a strategic guidance on the whole design process, whereas in the exploitation phase as the designer of the KPIs to be monitored. The latter acts in the exploration phase as an external knowledge source, whereas in the exploitation phase properly as the final user of the developed technology.

Finally, the façade manufacturer is involved only in the exploration phase, given its focus on the production phase of the innovative circular façade, and the facility manager and the asset owner are involved only in the exploration phase, given their focus on the usage phase of the innovative circular façade.

The close collaboration, in the exploration phase, among the service provider, the integrated design consultant and the façade manufacturer emerges also in the article by Hartwell et al. (2021), together with the role of the final users as external knowledge source. The service provider's focal role is the combination of the evidences of Giovanardi et al. (2023) and Hartwell et al. (2021), who give evidence of the important role of the service provider respectively in the exploitation and the exploration phase. Hence, we posit the critical role of the service provider in both exploration and exploitation phase with a managerial role. Facility manager and asset owner have an active role only in the exploration phase, in accordance to Giovanardi et al. (2023) and Hartwell et al. (2021).

Conversely, the actors involved and the roles performed in the linear façade value chain are much more scattered and independently performed one from each other. Indeed, in the linear façade value chain, the service provider is not part of the façade value chain. The value creation is performed solely by the integrated design consultant, which is not involved in value transfer and capture. The two focal actors of the linear façade value chain are the façade manufacturer and the facility manager. These two actors have direct contact with the final customers, who buys the façade. The linear façade value chain is thus highly fragmented, with the different actors involved only in specific phases of the whole value chain.

6 Conclusions

Our paper contributes to the literature in the interplay between circular economy and the building sector, with reference to buildings' façade, highlighting the key role of open and collaborative innovation in implementing circular economy principles in the façade value chain. Indeed, collaboration enables to jointly develop innovative circular product and business model and to identify in advance issues and/or mismatches that may arise along the whole value chain. For instance, the close collaboration between designers and manufacturers enables not to have mismatches between design and production phases by considering the whole product lifecycle when designing the circular product.

Through the action research methodology, we identified (i) the key actors involved in the façade value chain, (ii) each actor's role in the jointly and collaborative development of the innovative circular product (i.e. exploration phase), (iii) each actor's role in the jointly and collaborative development of the innovative circular business model (i.e. exploitation phase). We gathered the evidence emerged in a research framework, pointing out the actors involved in the exploration and exploitation phases and the role performed distinguishing among actors focused on a single phase and performing a specific role, actors involved in both phases but with different roles and actors involved in both phases performing the same role.

We posit that open and collaborative innovation is an important factor to be considered in the transition from linear to circular. However, several challenges have still to be tackled to fully exploit the potential of open and collaborative innovation when implementing circular economy principles in the façade value chain. Some anectodical challenging aspects emerged from our action research and could represent potential future research areas to be further investigated. These challenging aspects are (i) the needed for proper KPIs and indicators to align the different actors of the value chain toward common circular principles, (ii) the need for proper collaboration forms and contracts to ensure not only a short-term perspective (and short-term objectives) but also a long-term perspective (and long-term objectives), (iii) the need for a proper benefits' sharing mechanism between the service provider and the final users.

Finally, our paper is based on empirical evidence thus the main limitation could be represented by the bias given by the perspective of the companies, and people, involved in the Envelope for Service project. Moreover, the findings are

referred to the Italian context, given the national boundaries of the Envelope for Service project, and the here presented findings could be further enlarged and compared with evidences from different European countries.

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Food Safety Climate and Drivers in Italian Agrifood Companies

Mara Del Baldo*, Francesca Cesaroni, Massimo Ciambotti, Gail Denisse Chamochumbi Diaz, Daniele Giampaoli, Federica Palazzi, Annalisa Sentuti, Francesca Sgrò

University of Urbino Carlo Bo
Via Saffi, 42
Urbino (Italy)

** Corresponding author*

Abstract

This paper aims to investigate the impacts of food safety drivers on food safety climate of Italian agrifood companies. we empirically tested the relationship among food safety driver, leadership, internal communication, resources, and risk awareness. From March to May 2022, we gathered survey information from 168 Italian companies engaged in the agri-food industry. Results suggest that food safety drivers enhance each dimension of the food safety climate. This study is the first one that analyses the impact of food safety drivers on each food safety climate component, deepening the knowledge of the components of food safety climate in the Italian context. The main limitation of the present study is that we collected data from a single European Country and results cannot be generalized.

Keywords – Agrifood, Food Safety Culture, Food Safety Climate, Drivers, Italian Firms

Paper type – Academic Research Paper

1 Introduction

The agrifood has been defined by the EC as the combination of the primary sector and the food industry (EC, 2007). It stands out as one of the most important sectors in the European Union because of its contribution in terms of economic output and employment (Food Drink Europe, 2020), particularly in Italy (CREA, 2022) where a number of products are among the Italian excellences

representative of the "Made in Italy". Moreover, worldwide - including Italy - micro and small-sized enterprises (SMEs) represent the majority of agri-food companies (Banterle et al., 2016; Bentivoglio and Giampietri, 2016; Cesaroni et al., 2021). Global trends for the future of the agrifood system have forced companies to revise their business models (Tell et al., 2016; Zouaghi & Sanchez, 2016; Del Baldo, 2022) due to the growing attention paid by governments, NGOs and the civil community to sustainability, climate changes, food safety and health in the light of the effects which their production has upon health, natural resources and the communities in which they operate (Hartmann, 2011; FAO, 2019).

In this vein, food safety has come to the fore in driving agrifood companies to integrate it within their corporate strategies and implement food safety management systems (FSMS) (De Boeck et al., 2017) to take into account social, environmental, ethical, and human rights issues in collaboration with their stakeholders. On the regulatory front, in Europe, new principles for food safety control were established already in the 2000-2010 decade (Tomasevic et al., 2013). Nonetheless, throughout the years, instances of consumer food poisoning and outbreaks have persisted (European Parliament, 2019; Griffith, 2006), with the majority of these incidents attributable to food handler errors and/or non-adherence to food hygiene or safety procedures (Powell et al., 2011; Wright et al., 2012). Consequently, some researchers shifted their focus from a formal and technically driven FSMS to a more human-centric aspect of food safety, as demonstrated by the emergence of concepts like food safety culture and food safety climate (Powell et al., 2011; Taylor, 2011; Yiannas, 2009). However, both the scientific literature and empirical evidence regarding food safety remain limited (De Boeck et al., 2015). One of the key aspects is understanding whether and how the drivers pushing companies to adopt food safety practices and systems actually facilitate the creation of a food safety climate within the company. Therefore, this paper aims to investigate the impacts of food safety drivers on four "components" of the food safety climate of Italian agrifood companies. More precisely, we empirically tested the relationship among food safety driver, leadership, internal communication, resources, and risk awareness. Results suggest that food safety drivers enhance each dimension of the food safety climate. The paper is organized as follows: section 2 introduces the literature background and the literature framework, section 3 describes the methodological approach, section 4 presents and discusses the main results drawn from the empirical analysis, while section 5 points out conclusions and implications.

2 Literature review

Food safety has been defined as "the condition of the foodstuffs in all stages of production, processing and distribution, required to guarantee protection of consumer's health, also taking into account normal circumstances of use and information available for the food stuffs concerned" (Baert et al., 2011, p. 941). Shifting the attention from the "techno-managerial dimension" (control and assurance activities and processes) to the "human rotes" of food safety, the concepts of food safety culture and food safety climate (Gilling et al., 2001) have been introduced (De Boeck et al., 2015, 2017).

Food safety culture has been conceived as "serving an overarching, sense-making context for the creation and maintenance of food safety perceptions, attitudes and beliefs (Zohar, 2011). Namely, food safety culture has been defined as "the interplay of the food safety climate as perceived by the employees and the managers of a company (so called 'human route') and the context in which a company is operating" (De Boeck et al., 2015, p. 243).

Safety climate is typically described as the perceived importance or significance of safety within an organization or work unit, as seen by employees. This concept stems from individual perceptions and arises when workers interpret or assign meaning to their work environment (Zohar, 2011). As these perceptions become common among employees within the same work unit or organization, safety climate can be measured not only at the individual level but also at the group level. This suggests that safety climate is a collective phenomenon characterized by shared perceptions among employees (Zohar, 2011). These shared perceptions represent characteristics of the work unit or organization.

Food safety climate is commonly defined "as the perception of the individual employees regarding the food safety situation in their company". Namely, it has been defined in terms of shared perception of leadership, communication, resources and risk awareness (de Boeck et al., 2015).Therefore, food safety culture represents the bigger framework of which food climate is a component and can be interpreted as "the interplay of the food safety climate as perceived by the employees and the managers of a company and the context in which a company is operating" (De Boeck et al., 2015, p. 243).

According to Griffith et al. (2010) food safety climate includes four main components: leadership, internal communication, resources and risk awareness. Leadership can be described as the understanding of how well an organization's

leader can involve employees in adhering to hygiene and safety practices, as well as achieving compliance with the organization's objectives, vision, and standards related to cleanliness and food safety (Griffith et al. 2010). Organizations with superior leaders tend to be more productive and competitive (Griffith et al., 2010). Considering that an organization's climate originates at the top and cascades downward leaders should inspire employees to adhere to hygienic and food safety practices while establishing clear goals related to food safety and hygiene. It is also important for leaders to pay attention to employees' feedback or concerns regarding hygiene and food safety. Additionally, when employees feel that their opinions are valued and respected (Yiannas, 2009), they are more likely to be engaged and motivated. Internal communication is understood as the degree to which information related to hygiene and food safety is disseminated within an organization.

Leaders should have open lines of communication with their staff in order to ensure that they are aware of their tasks and responsibilities. This is especially important when it comes to stressing the importance of cleanliness and food safety. Leaders should communicate in a straightforward manner that is appropriate for the recipient's educational level. Allowing food handlers (operators) to freely address cleanliness and food safety issues with their bosses is another aspect of effective communication. This encourages organisational transparency and may have a good effect on the environment for food safety (Griffith et al., 2010). Employees are more likely to adopt this view if they are often reminded of the value of sanitation and food safety. Posters, placards, and other materials should be used to repeatedly emphasise the need of cleanliness and food safety (Yiannas, 2009).

Resources pertains to the perception of the availability of both tangible and intangible assets needed to maintain hygienic and food-safe operations, such as time, personnel, infrastructure, and education or training. When an organization provides adequate and skilled staff to manage hygiene and food safety, it allows each team member enough time to work in a hygienic and food-safe manner. This support can lead to a heightened motivation to maintain hygiene and food safety practices (Griffith et al., 2010). Also, the quality of the final products is probably greater when workers are not always under pressure. The availability of the essential infrastructure for preserving cleanliness and food safety, as well as the allocation of enough financial resources to support these efforts, are other indications of organisational support. Another aspect mentioned by Griffith et al.

(2010) is risk awareness, which refers to the organization's knowledge of hygiene and food safety issues and its capacity to successfully manage them. For an atmosphere of food safety to be good, risk perception is essential (Griffith et al., 2010). Workers need to be aware of hazards so they can weigh them in everyday decision-making. Employees will feel less stressed and that the company is succeeding if they have faith in the organization's food safety management system. They may be inspired to continue their commitment to food safety and cleanliness by this trust (Zhu & Akhtar, 2014). Overconfidence should be avoided, though, since it might result in an underestimation of the hazards to food safety (Griffith et al., 2010). Ultimately, it is vital for both leaders and employees to be risk-aware to ensure they have a realistic understanding of potential risks and respond appropriately (Griffith et al., 2010). If employees perceive leaders as overestimating or exaggerating hygiene and food safety risks, they may be less inclined to work in a hygienic and food-safe manner.

Drivers that motivate companies to adopt specific food safety practices and systems can be traced back to both internal and external factors (Palazzi and Sentuti, 2021). Among these, there are the improvement of corporate image and reputation (Aung & Chang, 2014; Corallo et al., 2020); the consistency with top management values (Schwartz et al., 2012) and the performance improvement prospects (Aung & Chang, 2014; Chan & Chong, 2013; Corallo et al., 2020).

Leaders are held more accountable for promoting and supporting food safety when the company's image and reputation are prioritised. To accomplish this, it is necessary to foster an organisational culture that prioritises food safety above all. The company's internal communication needs to be more open and honest if it wants to improve its image and reputation in the food industry. This has the potential to increase teamwork, raise awareness of food safety practises, and facilitate the exchange of helpful useful information for that purpose. Therefore, a business with public perception and credibility enhancement goals is more likely to allocate the resources essential to guarantee food safety. When it comes to food safety, businesses that care about their image pay closer attention to risk management and take greater precautions as incidents or scandals can seriously damage their image and reputation. To protect their reputation and customer trust, businesses exercise extreme caution when it comes to handling food safety issues.

Aligning management values and goals with operational procedures ensures consistency with the ideals of top management. Leaders in an organisation are

more likely to prioritise food safety by setting an example when their own values align with those of the business, inspiring and motivating others to do the same. Furthermore, when top-down communications are clear and consistent with their values, staff members have a better grasp of the significance of food safety and are more likely to share information, discuss difficulties, and work together to accomplish the company's food safety goals. If this is the case, the corporation will be more likely to invest in the appropriate tools and controls, fostering an atmosphere where workers can do their jobs well and ensuring the safety and quality of products. Finally, people are becoming more aware of the risks associated with food. Workers are expected to identify and report any issues they come across as well as actively participate in risk management. The connection of leadership's values and operational practises in this area promotes a culture where food safety and risk management are given priority. Long-term success of a firm may depend on its commitment to food safety, which will be given priority by management when performance improvement is the main objective. With internal communications that emphasise the free exchange of information, goals, and progress relevant to food safety, employees will be motivated to collaborate in order to achieve their objectives and enhance the performance of the business. Investing in resources like sufficient equipment and monitoring and control systems to guarantee food safety will be crucial to the success of any firm. Food safety mishaps and scandals, which could harm the company's brand and performance, will be avoided as a result of the company's increased focus on risk management. We therefore hypothesized that:

H1: drivers (DRIVER) have a positive impact on leadership (LEAD);
H2: drivers have a positive impact on internal communication (COMINT);
H3: drivers have a positive impact on resources (RESOURCES);
H4: drivers have a positive impact on risk awareness (RISK).

3 Methodology

The population of companies has been extracted from the Atoka database, and includes the sectors of Agriculture, Manufacturing and Fishing. A total of 4614 companies were extracted, of which 3177 without certifications and 1437 with certifications. Two questionnaires were administered: the first was addressed to the entire population of companies, while the second was aimed at investigating specific aspects of companies with certifications. From March to May 2022, we

gathered survey information from Italian companies engaged in the agri-food industry. 168 companies around 14% of the 3177 firms participated in the study. All of the questions were completely filled out, so none were disqualified. Approximately 4% of the businesses had up to 9 employees, 73% had 10–49, and 21% had between 50–249 workers, while the remaining 2% counted more than 250 employees. Scales for Food Safety Climate were taken from Boeck et al. (2015) while scale for driver was adapted from previous works of Aung & Chang (2014), Chan & Chong (2013), Corallo et al. (2020), Schwartz et al. (2012).

We tested reliability, convergent and discriminant validity of the scales (Hair et al, 2014). No items were dropped because all the factor loading are above the recommended threshold. Results are shown in Table 1 and Table 2.

Table 1: Reliability and convergent validity

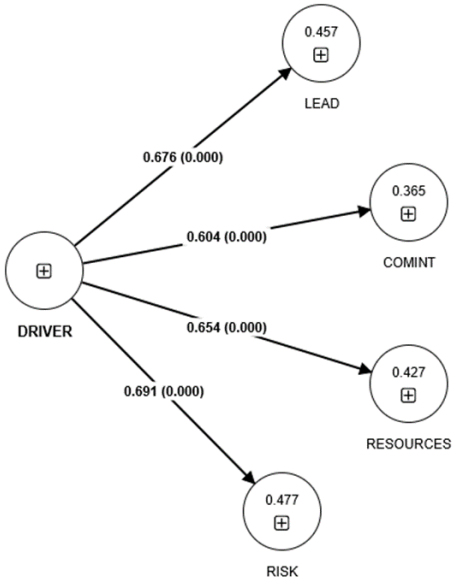
Inherent variables	**Items**	**Loadings**	**Cronbach's alpha**	**Dillon-Goldstein rho**	**AVE**
COMINT			0.909	0.917	0.789
	COMINT1	0.947			
	COMINT2	0.950			
	COMINT3	0.861			
	COMINT4	0.785			
DRIVER			0.878	0.892	0.805
	DRIVER1	0.841			
	DRIVER3	0.926			
	DRIVER4	0.921			
LEAD			0.893	0.911	0.757
	LEAD1	0.793			
	LEAD2	0.914			
	LEAD3	0.883			
	LEAD4	0.886			
RES			0.891	0.913	0.753
	RES1	0.863			
	RES2	0.885			
	RES3	0.823			
	RES4	0.898			
RISK			0.958	0.959	0.888
	RISK1	0.936			

	RISK2	0.950			
	RISK3	0.946			
	RISK4	0.939			

Table 2

	Fornell-Larcker				
	COMINT	**DRIVER**	**LEAD**	**RISK**	**RES**
COMINT	0.888				
DRIVER	0.604	0.897			
LEAD	0.823	0.676	0.870		
RISK	0.799	0.691	0.832	0.943	
RES	0.768	0.654	0.789	0.832	0.868

We utilized PLS-SEM, a structural equation modeling method. This variance-based technique does not necessitate a normal data distribution (Hair et al., 2014) and is ideal for exploratory research, as it can handle complex models (Benitez et al., 2020). Furthermore, PLS is the most appropriate choice when the data's nature as a common factor or composite is uncertain, as it generates less estimation bias compared to CB-SEM. To assess the statistical significance of outcomes such as path coefficients, Cronbach's alpha, HTMT index, and R-squared values, we employed a bootstrap algorithm (Hair et al., 2014).



Results (Figure 1) show that all the hypotheses are supported (Table 3). Specifically:

- H.1 DRIVER -> LEAD: evidence support H3 (β=0.676, p=0.000) confirming that DRIVERS have a positive impact on leadership (LEAD).
- H.2 DRIVER -> COMINT: evidence support H3 (β=0.604, p=0.000) confirming that DRIVERS have a positive impact on internal communication (COMINT).
- H.3 DRIVER -> RESOURCES: evidence support H2 (β=0.654, p=0.000) confirming that DRIVERS have a positive impact on resources (RES).
- H.4 DRIVER -> RISK: As we hypothesized DRIVERS have a positive impact (β=0.691, p=0.000) on risk awareness (RISK).

4 Conclusions

This study investigates the impacts of food safety drivers on four "components" of the food safety climate of Italian agrifood companies.

We discovered that various factors influencing food safety interact with food safety climate elements. The presence of these factors, and the interactions between them and the food safety climate variables, all combine to make food safety a top priority in the workplace. To maintain a high standard of food safety and improve overall performance, businesses need to actively promote these drivers and keep them aligned with the food safety climate components. Long-term sustainability of this equilibrium depends on businesses' vigilant monitoring of their food safety performance and responsiveness to shifting market needs.

On the one hand, this study analyses the impact of food safety drivers on each food safety climate component and allows to deepen the knowledge of the components of food safety climate in the Italian context. On the other hand, it represents the first survey of the Italian context that provides interesting insights useful to improve the knowledge of agrifood companies on food safety drivers and impacts, being that the study is part of an interdisciplinary research project funded by the University of Urbino aimed to understand how agrifood companies interpret the issue of food safety, how they internalize it in strategic choices and implement it in their business activities and supply chain relationships and how they communicate it to stakeholders.

The main limitation of the present study is that we collected data from a single European Country and results cannot be generalized.

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PM Role on Sustainability Objectives

Antonio Bassi*, Jonathan Bertossa, Simone Cirelli, Katiuscya Gianini-Cusumano, Michela Manini Mondia, Cendresa Rexha, Juri Rodoni, Simona Sala Tesciat, Christian Sefrin, Raffaele Scarinzi, Malcolm Tunzi

Department of Innovative Technology
University of Applied Science and Arts of Southern Switzerland
Polo Universitario Lugano – Campus Est, Via La Santa 1, CH-6962 Lugano-Viganello, Switzerland

* *Corresponding author*

Abstract

Very often, sustainability is rooted in the genes of companies, establishing in-house programmes and projects that aim to achieve a level of sustainability over time that is integrated into corporate strategies.
The concept of sustainability initially originated in relation to the environment but recently it has been also implemented in other areas such as social impact and good governance. These three macro aspects are recognised by the acronym E.S.G - Environmental, Social, Governance - and are also indicators that allow to analyse the activity of a company, not only on financial aspects, but also from an environmental, social, and good governance perspective.
Companies will have to move from a model in which they simply consume materials, energy, time, and human resources skills to one in which they instead manage a responsible relationship with materials, energy, and people values. It will be necessary to go through a very important transition to prepare their organisation, their production infrastructure, their people, and their governance to support this new model.
The role of the PM in these transitions is of fundamental and absolute importance.
The research will focus on the following topics:

- Identification.
- PM & Sustainability.
- Environmental.
- Social.
- Governance.

The purpose of the entire research is to analyse the current situation and to assess the maturity of project managers and organisations with regards to the topic of sustainability,

measuring in particular ESG (Environmental, Social and Governance) aspects and establishing whether these criteria are used within the project management context.
With this data and information, it will be possible to identify which components have the greatest potential for improvement, and it will be possible to make project managers and organisations aware of project sustainability aspects.
The Department of Innovative Technologies (DTI) of the University of Applied Sciences and Arts of Southern Switzerland (SUPSI), as a training and research institute, will therefore be able, on one hand, to define courses or study programmes to fill these gaps; on the other hand, to continue to disseminate useful information and content on the subject and to raise awareness in organisations of the importance of sustainability in project management.

Keywords: sustainability, project manager, role, ESG, sustainability project

Paper type: Academic Research Paper

1 Introduction

Very often, sustainability is rooted in the genes of companies, establishing in-house programmes and projects that aim to achieve a level of sustainability over time that is integrated into corporate strategies.

The concept of sustainability initially originated in relation to the environment but recently it has been also implemented in other areas such as social impact and good governance. These three macro aspects are recognised by the acronym E.S.G - Environmental, Social, Governance - and are also indicators that allow to analyse the activity of a company, not only on financial aspects, but also from an environmental, social, and good governance perspective.

Companies that choose to adhere to the E.S.G. protocol with international standards (e.g., the UN Sustainable Development Goals) are going to focus on these three macro aspects, guaranteeing the compliance with certain measures and setting goals to be pursued in the medium and long term.

Companies will have to move from a model in which they simply consume materials, energy, time, and human resources skills to one in which they instead manage a responsible relationship with materials, energy, and people values. It will be necessary to go through a very important transition to prepare their organisation, their production infrastructure, their people, and their governance to support this new model.

The role of the PM in these transitions is of fundamental and absolute importance, and for this reason, the Department of Innovative Technologies (DTI)

of University of Applied Sciences and Arts of Southern Switzerland (SUPSI), launched this study in September 2022, focusing on how the role of the PM can be a key player in corporate sustainability goals.

2 Methodology

2.1 Design/methodology/approach

We developed our study through a survey, which targeted a selected group of companies located in Switzerland and Italy, which operate in different sectors, are of different sizes, ranging from small, medium, large, and operate both locally and globally.

The survey was conducted through an online form of 25 questions. The answers were then analysed by the research participants; the data were first analysed in their complexity and then analysed in detail to focus on certain themes.

More specifically, we decided to focus our research on Ticino (Italian part of Switzerland) and Lombardy (northern Italy). This is because these two regions have a lot in common in terms of the economic situation and the types of companies that are present. In addition, these two regions constitute the catchment area of SUPSI, the promoter of this research.

Previous SUPSI Project Management graduates were also invited to participate in the survey.

The survey covered the following topics:

- Identification: Information about the context in which the participant operates, information about the company and its structure and how it integrates sustainability policies into the company, often linking them to their brand.
- PM & Sustainability: Information on how the PM is integrated in the activity of achieving Sustainability goals, information on how the PM can intervene within the company to raise awareness and promote E.S.G. issues.
- Environmental: How PM can impact sustainability on an ecological level related to the environment
- Social: How PM can implement aspects of social sustainability on Diversity, Equity, and Inclusion issues

- Governance: How PM's contribution can generate value and positively impact the various levels both from an organisational and strategic point of view and good governance by creating innovation, research, and incubation.

2.2 Goal of the research

The purpose of the entire research is to analyse the current situation and to assess the maturity of project managers and organisations with regards to the topic of sustainability, measuring in particular ESG (Environmental, Social and Governance) aspects and establishing whether these criteria are used within the project management context.

What emerged from our research is that only large companies have resources dedicated solely to the topic of sustainability; small and medium-sized companies, on the other hand, must somehow make do with the resources they already have in house. Very often, therefore, it is the project manager who finds himself in this role. Even in the case of large companies, however, a control and monitoring role is still assigned to the project manager.

For this reason, it was important for our research to interview project managers.

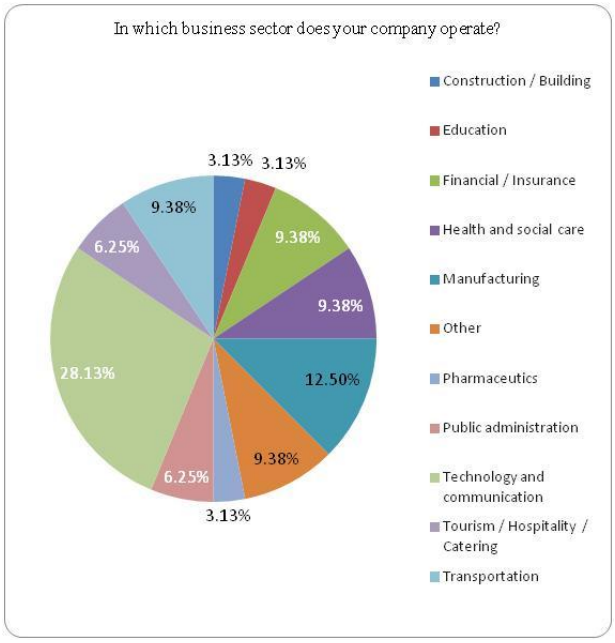
3 Results of the survey

In this chapter we will describe the results obtained by considering the interaction

between the survey questions according to the objectives set.

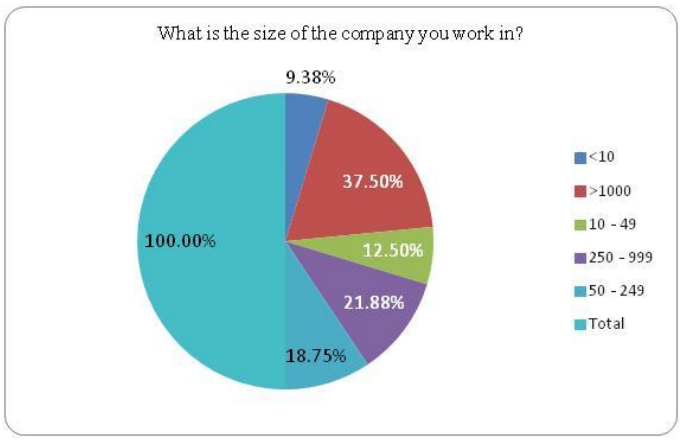
3.1 Identification

Referring to the identification area, the results show that a large proportion of the respondents, 28.3%, work in the technology and communications sector. The remaining sectors that see a good number of employees are Manufacturing with 12.5% followed by Finance / Insurance, Health and Social Care, Transport / Circulation all with 9.38%.



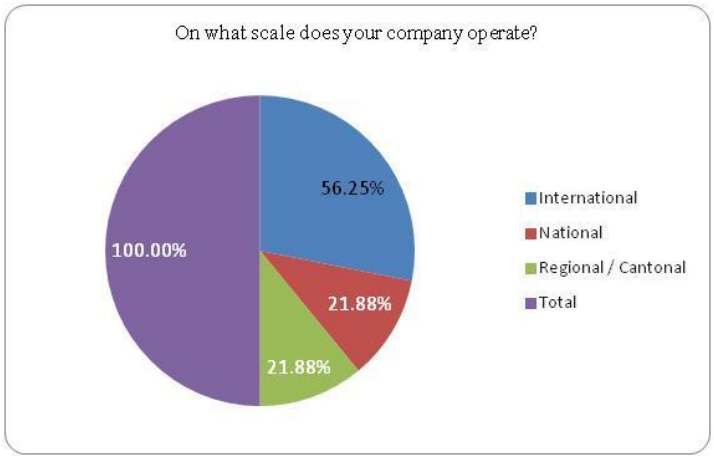
3.1.1 Identification – Company sector

Most of the organizations that took part in the survey have a size of 1000 employees or more (large organizations) with 37,50% of respondents. Other categories have similar values.



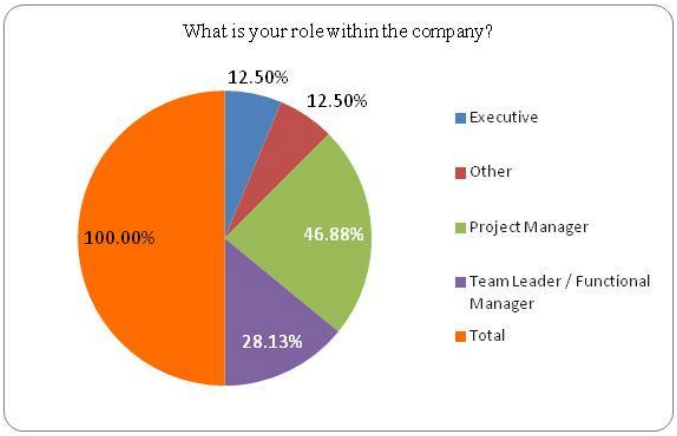
3.1.2 Identification – Company size

Most of the respondents work in companies that operate on an international scale, with 56.25% of respondents. We can see that the National scale and regional scale are similar with the 21.88% of respondents.



3.1.3 Identification – Company scale of operation

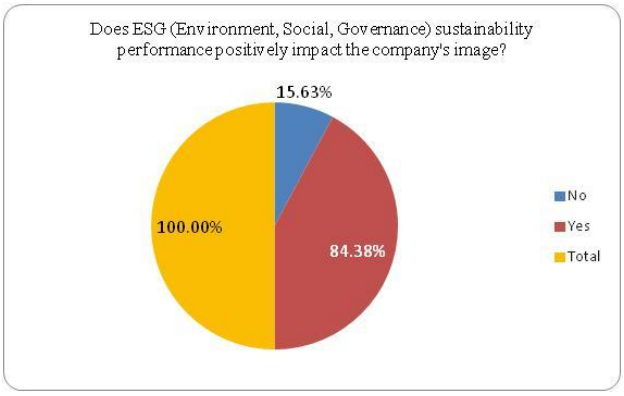
Most of the respondents are employed in the company as project managers; 46.88% of the respondents belong to this category. We also see a good proportion of team leaders/functional managers, 28.13%.



3.1.4 Identification – Roles of the respondents

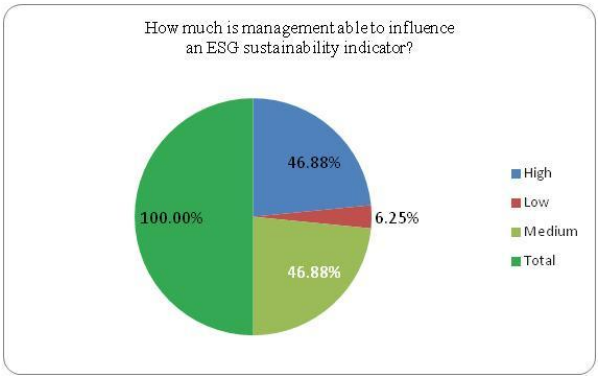
A large proportion of respondents believe that ESG (Environment, Social, Governance) sustainability performance has a positive impact on the company's

image. As many as 84.38% of the respondents, in fact, found the impact to be positive.



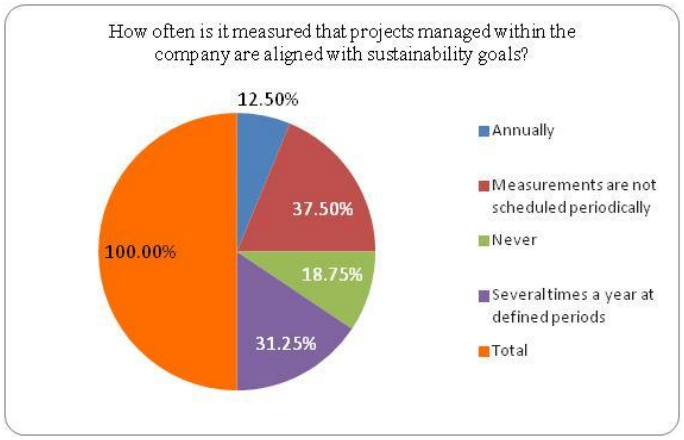
3.1.5 Identification – Impact of ESG factors on company's image

As far as management influence is concerned, only a very small percentage of 6.25% considered it to be zero with respect to ESG indicators. Almost all respondents believe that management can influence an ESG sustainability indicator.



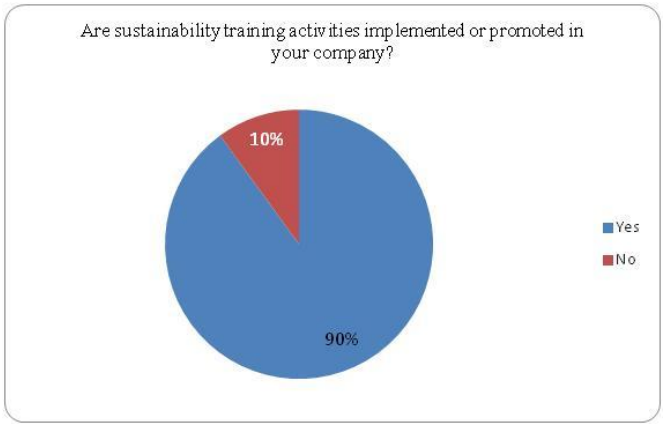
3.1.6 Identification – Influence of the management on the ESG factors

Another question in the survey aimed to establish how often the alignment of managed projects with sustainability goals is measured. It is good to appreciate that in 81.25% of the cases, measurements are actually carried out.



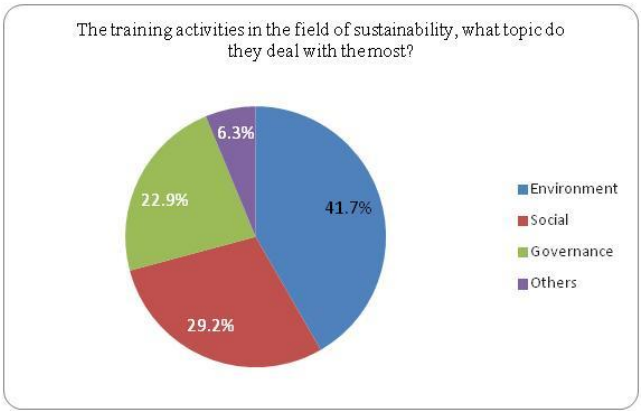
3.1.7 Identification – Frequency of monitoring

Finally, the survey showed that in 90% of companies, training activities dedicated to sustainability are implemented or promoted.



3.1.8 Identification – Presence of training activities

In 41.7% of the cases, it is training in the environment sphere, while in 29.2% of the cases, it is the social sphere that is concerned. The governance sphere closes with 22.9%.



3.1.9 Identification – Topics of training activities

3.2 Project managers and sustainability

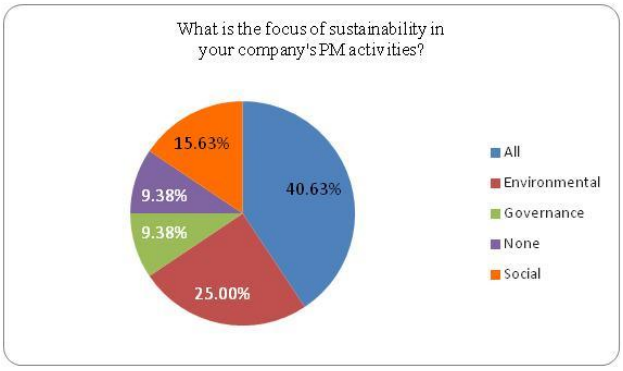
When we talk about sustainability, we mean the possibility of executing a project, which involves the balance between resource consumption and resource regeneration. But we also mean the possibility of performing an action that can satisfy our needs, without compromising the possibility for generations to come to do the same.

We could divide the whole concept into three parts:

1. Environmental sustainability: its prerogative is to ensure the stability of the environment and our planet, therefore, to maintain ecological and respectful processes that do not pollute or waste.
2. Social sustainability: it consists of balancing the available resources without compromising the possibilities for generations to come.
3. Governance sustainability: the development of integrated and rigorous sustainability is based on a solid and efficient governance structure. This is the basis for initiating a solid process of shared value creation between the parties.

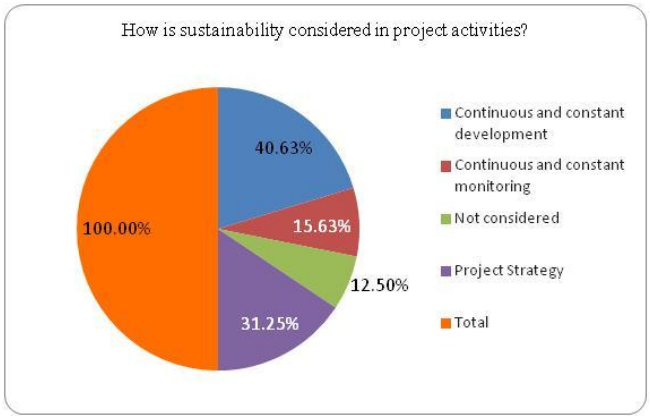
All the companies interviewed are unanimously supportive of this concept. Sustainability is therefore taken into account in a project, so that it can be developed and adapted to current needs.

The chart 3.2.1 aims to understand what the focus of sustainability is in companies.



3.2.1 PM and Sustainability – Focus of company's PM activities

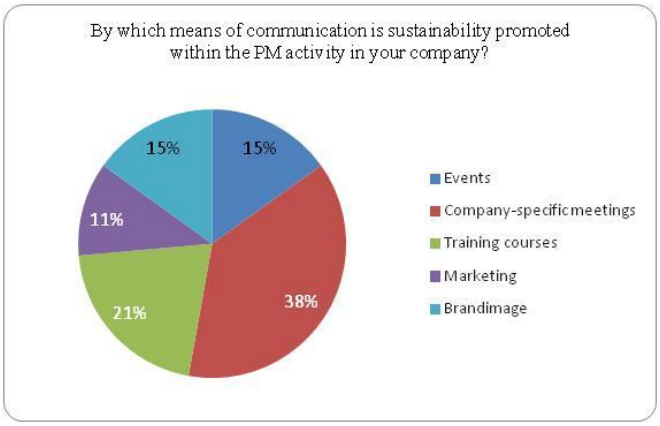
The majority of the companies surveyed give unanimous importance to all parts, demonstrating a great deal of responsibility for creating sharable and sustainable results. If we were to look at individual topics, environmental sustainability is the one that is taken into consideration the most; this highlights a greater sensitivity to the environment and pollution of our planet. The social theme is also of undoubted importance in a project in order to develop and complete it. Governance, on the other hand, is given marginal consideration. Finally, it is pleasing to note that the total absence of sensitivity to sustainability is a marginal condition, 12,50% of the companies involved in the survey.



3.2.2 PM and Sustainability – Sustainability in project activities

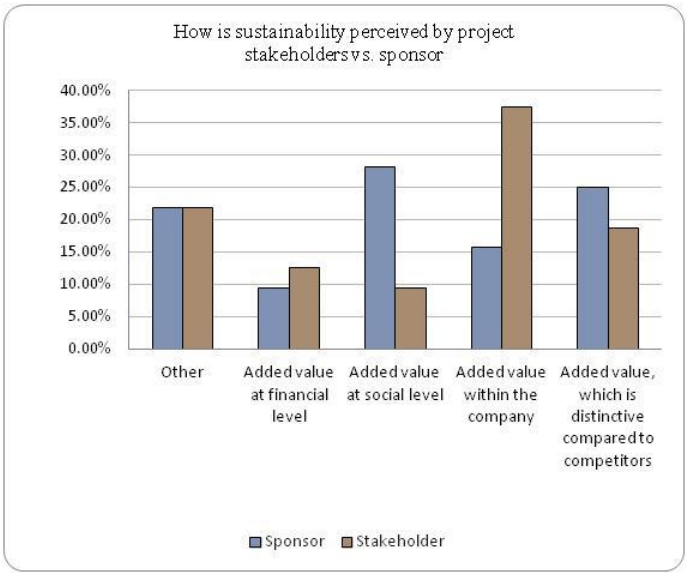
As can be seen in the graph 3.2.2, the majority of respondents see sustainability as continuous and constant development; there is a continuous commitment to improvement, documentation, and discussion in order to enhance and deepen

every aspect. As we see in the graph, sustainability is also seen as an integral part of the project strategy; it is here that decisions can be influenced in order to achieve the set sustainability goals. The monitoring factor is also important; this confirms that companies want to have a monitoring process that assesses whether the set aspects are actually achieved.



3.2.3 PM and Sustainability – Sustainability promotion

When it comes to the promotion of sustainability in the company, the graph 3.2.3 shows that in most cases (38%) this takes place during specific company meetings. On these occasions, employees are explained in detail about the company's efforts and various sustainability-related activities are promoted. Moreover, in the case of large companies, these take the form of important moments of confrontation between various departments. Other equally popular means of communication are events (also open to external audiences), information paths and brand image activities. Pure marketing is not as popular as a tool; this is understandable, since marketing is usually used for external communications, whereas more specific and customized tools are used for communications to employees, in this case to project managers.



3.2.4 PM and Sustainability – Sustainability perception

The chart 3.2.4 compares sponsor and stakeholder perceptions of value and highlights the objectives they have on sustainability. Stakeholders are more interested in creating added value within the company, while for sponsors this is not a priority area. On the contrary, the Sponsor tends to put more emphasis on the social aspect, believing that it is the contribution to society as a whole that gives more prominence to their project. Finally, both parties consider the distinctive added value compared to competitors to be relevant. In this sense, it is the common opinion of stakeholders and sponsors that conscientiously setting and committing to sustainability values can give advantages in terms of visibility and reliability towards customers. The added value on the financial level, in the end, is only marginally taken into consideration; undoubtedly setting sustainability goals can lead to an increase in turnover and margin, but these are not the main drivers of sustainability in project management.

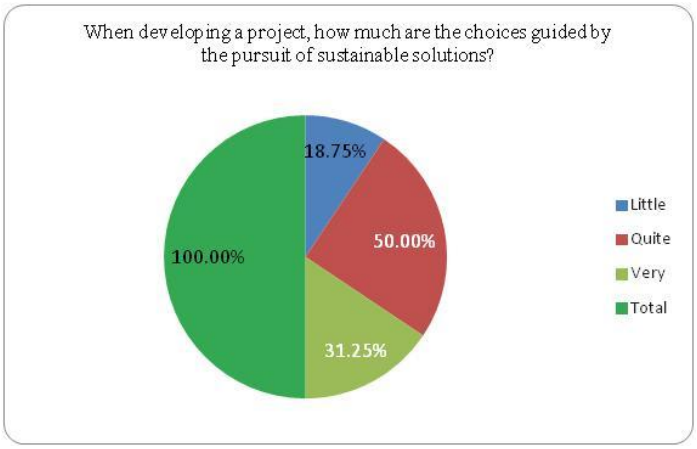
3.3 Environmental

Concepts related to environmental sustainability were certainly one of the first aspects introduced in companies as they are very concrete and tangible actions by the entire society.

The concept of environmental sustainability refers to the entire process of change in which the utilization of resources, the investment plan, the orientation of technological development and institutional changes are all in tune and enhance the current and future potential to meet society's needs and expectations.

This means not only being green or emitting less CO2, but a whole process that considers waste, the market (demand), the life cycle of a product (durability), the materials/resources used, and the production process.

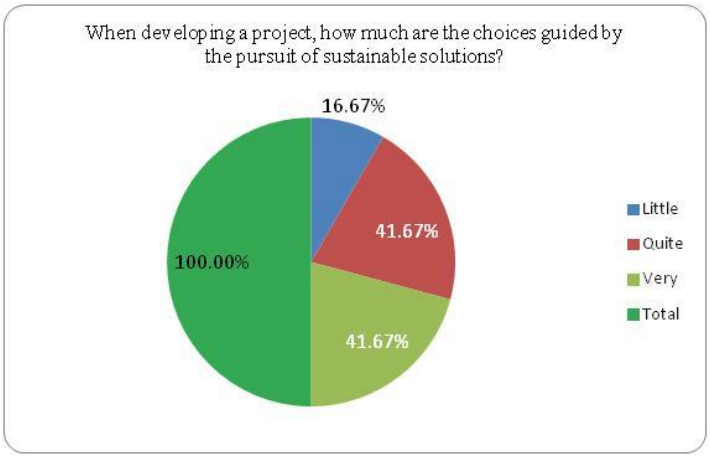
Consequently, at the beginning of a new project, these aspects must be analysed and taken into account to achieve the objectives and help the company to be sustainable during the evolution of the project and in the life cycle of the future product or service once the project is completed.



3.3.1 Environmental – Sustainable solutions during project development (total sample)

Taking the global sample of respondents as a reference, 68.75% of them state that little (18.75%) or quite (50%) consideration is given to the search for sustainable solutions during the project phases, so it does not seem to be an established, consolidated practice to assess sustainability aspects from the beginning of a project.

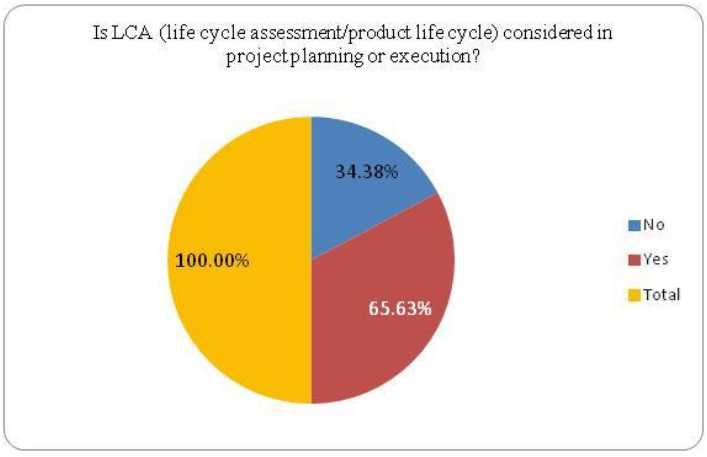
If we filter our sample, we notice that company size influences this practice. Indeed, large companies (>1000 employees) indicate that for 41.67%, sustainability aspects are highly considered during the design phases, so there seems to be a greater sensitivity on this issue.



3.3.2 Environmental – Sustainable solutions during project development (big companies with more than 1000 employees)

Life Cycle Assessment (LCA) is a methodology for assessing the environmental impacts associated with all phases of the life cycle of a commercial product, process, or service. The chart 3.3.3 shows that 65.63% of the companies in which our respondents operate, LCA is considered, compared to 34.38% who do not take these aspects into account.

Again, filtering by company size shows that the larger the company, the more life cycle assessment is considered during the design stages to have a more sustainable product, service, or process.

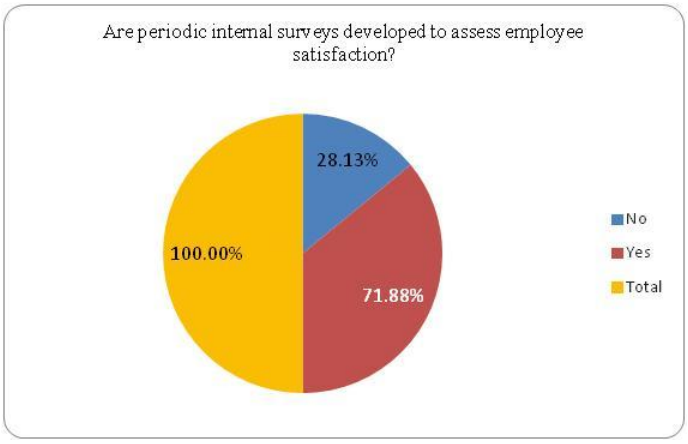


3.3.3 Environmental – LCA consideration

3.4 Social

Large organisations consider the social impact for their employees, and in recent years, even SMEs are making efforts to adopt a socially sustainable philosophy that influences the market to their advantage.

As we can see from the chart 3.4.1, 71.88% of companies develop surveys to understand the needs of their employees.



3.4.1 Social – Employee satisfaction monitoring

Conducting periodic surveys to assess employee satisfaction is important for several reasons:

- Internal surveys can help the PM to identify possible problems and to organize a clearer and more precise workflow, such as: processes, list of activities to be carried out, timelines, identification and exchange with stakeholders and choice of KPIs to monitor the progress of the project.
- For the PM, regularly collecting feedback from the team and acting on the results can help improve the retention of the team working within the project.
- Creating a fulfilling work environment increases productivity and quality of work and generates the lowest number of errors within the project, speeding up internal processes, tracking the progress of the project, increasing the well-being of the team, communication transparency brought by the PM, but above all the focus on the most valuable activities.

- Satisfied employees improve the reputation of the company and the ability to attract new specialized talent to join the project team.

In addition, the company that assesses the satisfaction of its employees can create benefits packages tailored to their needs; unfortunately, as we can read from the chart above, 28.13% of organisations do not consider a screening on the well-being and needs of their employees.

Companies that aim for social responsibility maintain a complex balance between ecological philosophy, personal convictions, and the goal of achieving maximum productivity.

In this sense, a duality of non-financial factors related to the social responsibility of PMs must be considered, which interact with each other for business success:

- On one hand, we find the company and the environment in which it operates. Here, the PM has the ability to improve customer relations and create greater loyalty; enhance brand image and brand reputation with investors; help reduce legal and regulatory risks; and develop better performing external relationships based on mutual satisfaction.
- There are several practices that companies together with PMs can adopt to become socially sustainable, for example:
    - engaging in social responsibility projects, such as donations to non-profit organizations.
    - sponsorship of charity events or volunteer programmes.

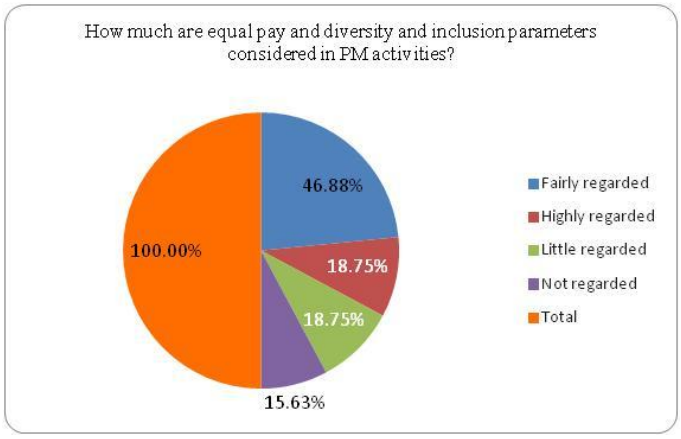
On the other hand, organizations can also work to improve conditions for their employees, such as providing fair wages; health benefits; workers' rights and gender equality; a healthy and functional work environment; safety at work; satisfied employees; improved turnover; attracting new talent and inclusion of people.

Again, there are many tools that a company can adopt in cooperation with PMs in the development of activities, in order to gain solid engagement in the work team and provide good welfare. Here are some examples:

- insurance policies for health, life, disability, and other contingencies.
- wellness programmes including gym, yoga classes and nutritional counselling.
- work flexibility with the option to work from home, have flexible working hours or share work with colleagues.
- on-site childcare or discounts for external services.

- training and professional development to help employees improve their skills and advance their careers.
- financial incentives such as bonuses, awards, salary increases or stock options.
- counselling and assistance with personal or family problems, psychological support, or legal advice.
- paid leave and time off for family emergencies, holidays, or sick days.
- collaborative networks such as platforms for linking various digital tools and sharing materials and projects, chat rooms, videoconferencing, corporate social.

From the chart 3.4.2, we can see how much the PM's activities consider equal pay, gender equality and the inclusion of people in project teams.



3.4.2 Social – Equal pay, diversity, and inclusion as parameters

Within the survey area, only 18.75% of the companies are visibly oriented towards sustainability and the PM implements crucial factors in creating a cohesive and motivated team to achieve project goals as effectively as possible.

To ensure social sustainability, appropriate measures must be taken, such as:

- the systematic review of recruitment and promotion policies, including those of work teams.
- staff training to prevent unconscious bias.
- the creation of a safe and inclusive working environment in the operational team.
- the introduction of parental leave policies.

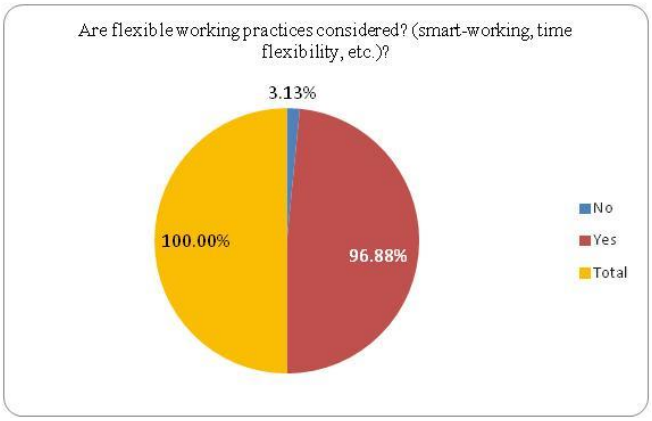
- other reconciliation measures such as work life balance that facilitate teamwork and limit conflicts.

In summary, attention to the equality variables is crucial to the success of the project, as they contribute to a collaborative, innovative and motivating working environment that fosters good results.

46.88% of the companies apply these criteria sufficiently, but not yet satisfactorily. In the end, we can clearly see that many organizations are not in line with the ESG indicators aimed at sociality. In fact, 18.75% consider the above-mentioned aspects too little and 15.63% totally neglect the fundamentals of employee welfare, projects, and the organization itself.

In the last chart 3.4.3, however, we see that as many as 96.88% of organizations apply flexible forms of work.

Responses to the changes that have taken place in recent years have accompanied this evolution with dynamic scenarios and different approaches from the traditional organization.



3.4.3 Social – Flexible working

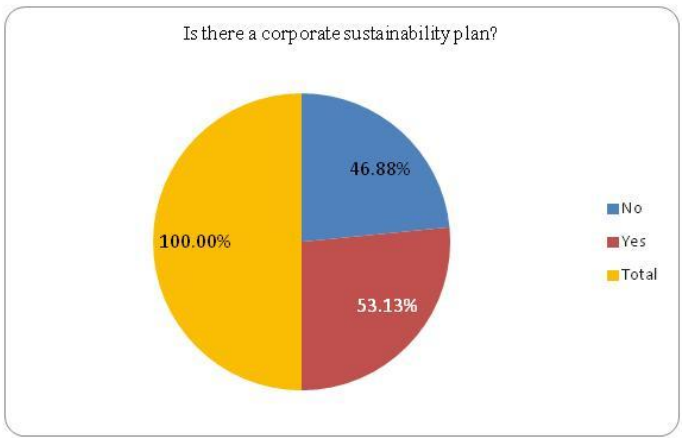
Smart working and work flexibility in project development are now part of corporate welfare policies that bring both benefits to employees in terms of improved work life balance, and to companies in terms of reduced maintenance costs, reduced absenteeism, and productivity growth, but above all it creates the desire to increase engagement, attraction of so-called talents, and bringing within the new modality an improvement in organizational well-being and business processes.

Therefore, putting the person at the centre and building relationships based on trust and mutual development between PM and employee embraces this new approach to work and contributes to providing multiple personal and professional benefits.

3.5 Governance

Project management is a critical factor for the success of any initiative, including those with sustainability objectives. Project managers play a crucial role in the governance of a project, and their decisions can significantly impact the sustainability outcomes of a project. Therefore, it is essential to understand the role of project managers in achieving sustainability objectives and the governance structures that facilitate their decision-making processes.

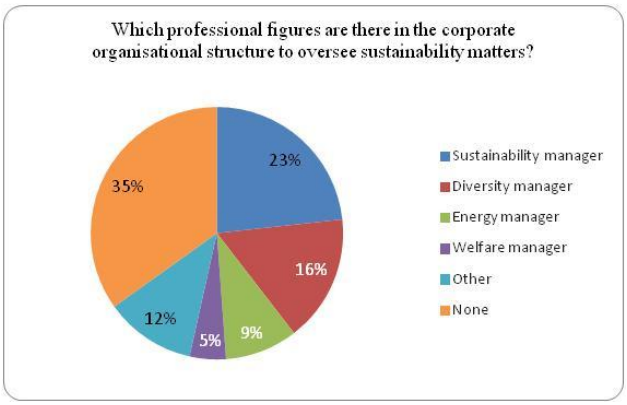
As the chart 3.5.1 depicts, almost half of the companies included in the survey have not a corporate sustainability plan. Conversely, the 53% indicated that their company has a plan in place, meaning this information can be used to gain insights into the current state of sustainability practices in the surveyed companies. These insights could be used to understand that the development of strategies to improve sustainability practices in the business world is not yet common practice.



3.5.1 Governance – Corporate sustainability plan

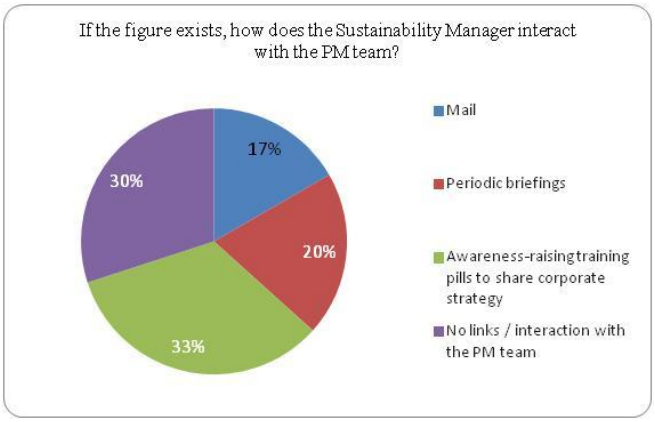
The following chart 3.5.2 shows how the different professional figures are distributed within the companies, if any. Almost 35% of the companies surveyed have no person responsible for sustainability issues. The other percentages are

distributed as follows: 23.3% by the Sustainability manager, 9.3% by the Diversity manager, 4.7% by the Welfare manager and 11.6% by other figures within the company. These values allow us to better understand the maturity of these companies and their attitude towards sustainability. The results suggest that there is a growing trend among companies to assign responsibility for sustainability to at least one person.



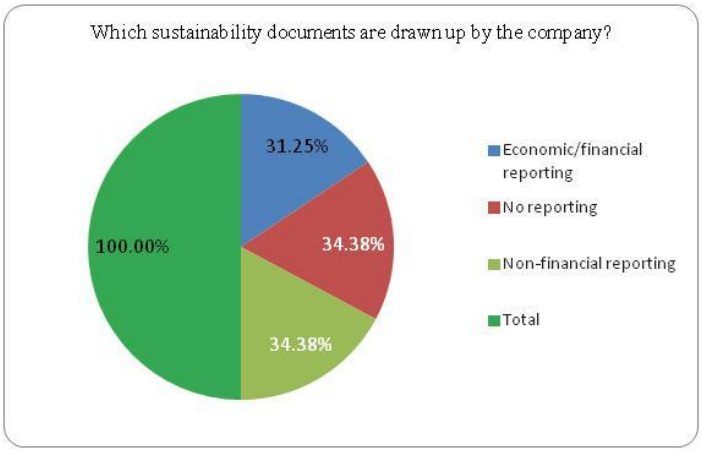
3.5.2 Governance – Professional figures to oversee sustainability

The chart 3.5.3 may explain how communication to and from the sustainability manager to the project management team usually works. Most are handled through awareness-raising training and the sharing of company strategy (33.3%). About 20% of companies organize regular meetings to discuss sustainability issues and 16.7% use written form, such as e-mail. What remains is that almost ⅓ have no interaction between the sustainability manager and the PM team. This situation lays the foundation for improvement in terms of communication and collaboration between the sustainability manager and the PM team in many companies.



3.5.3 Governance – Interaction between sustainability manager and PM team

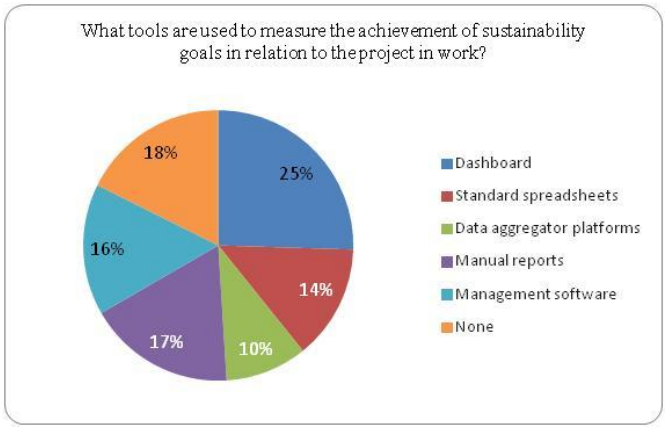
This chart 3.5.4 can help us understand if there are companies that write sustainability-related documents and which ones. As illustrated, the division is one third for each of the fields, i.e., financial reports, non-financial reports, and no reports. This information can be useful to understand the extent to which companies are reporting on their sustainability practices.



3.5.4 Governance – Sustainability documents

One of the most important charts is the 3.5.5 below, which shows that for 25.5%, dashboard tools are the most used to measure and verify the achievement of sustainability goals, followed by manual reporting (17.6%). Management software and spreadsheets are used by 15.7% and 13.7% of the companies respectively, while data aggregation is used by 9.8%. Furthermore, for about

17.6%, there are no measures to understand the achievement of objectives. This leads to the conclusion that there is still room for improvement in the use of tools and systems that can help companies understand the status and results of their sustainability targets.



3.5.5 Governance – Measuring tools

3.6 Additional feedback

To further confirm the validity of the survey responses, we asked an experienced project manager to comment on some specific topics.

We interviewed Stefano Santambrogio, who now holds the position of "Continuous improvement and sustainability manager" at Argo Heraus, a company with more than 15,000 employees, which operates internationally in the metallurgy and precious metals sector.

Santambrogio believes that the survey results are quite representative of the current situation of companies regarding sustainability management. However, there are some areas where, in Santambrogio' s opinion, companies could focus more on improving their sustainability practices.

In particular, Santambrogio believes that the interface between the sustainability manager and the project management team is of key importance for the integration of sustainability into the core activities of the company. Therefore, companies should invest in training and raising the awareness of the project management team on sustainability and corporate strategy.

Furthermore, the use of automated measurement tools could be an important step to monitor the achievement of sustainability goals and to identify areas for

improvement. Companies should consider using dashboards, management software and data aggregator platforms to improve their sustainability management.

Finally, Santambrogio believes that reporting and promoting a culture of sustainability are important to improve transparency and communication with stakeholders. Companies should consider drafting sustainability documents and invest in training and awareness-raising for all employees on sustainability.

In general, Santambrogio' s opinion is that companies should actively engage in integrating sustainability into their core business activities and promote a more sustainable future. Taking these actions could be an important step towards this goal.

4 Conclusions

Large international companies have led the way by adopting ESG goals as a corporate philosophy in order to boost their attractiveness and reputation. The PM activity, a focus in organizations undergoing transformation, plays a central role in aligning project management and support for sustainability goals.

To support these objectives, new specialized figures such as Sustainability, Diversity, Energy and Welfare managers have emerged to ensure targeted skills, minimize errors and training costs, and create added value for the company and the product/service.

Active and effective communication regarding the monitoring of achieved sustainability results also plays a primary role in ensuring that stakeholders are always informed about the economic and cultural efforts that the company implements on a daily basis during the course of its operations.

This summary document makes explicit how companies are structuring (or intend to re-structure) their operations to minimize any possible sources of negative environmental, social, and economic impact.

Implementing and promoting a business strategy devoted to sustainability and supporting consumers who increasingly seek out companies in line with these values reinforces the following benefits:

- better cost management.
- more careful use of economic and non-economic resources (raw materials, diversity, inclusion).
- better control of problematic situations.

- increased quality of products and services.
- positive effects on corporate reputation.
- greater stakeholder adherence.
- new possibilities for innovation and economic development.

Following the example of large companies, today even SMEs are moving towards a more sustainable philosophy, investing in change and their project managers taking on an increasingly multifaceted role to ensure that projects are aligned with ESG sustainability goals.

Sustainability has therefore become a key factor in project management and represents an important strategic asset for companies, but also and above all for investors who recognise its importance by selecting companies that have solid policies towards employees and thus invest in those with the best prospects for growth and lowest risks.

The PM must ensure that projects are implemented in a sustainable manner, using renewable energy sources, reducing waste and residue, and minimizing pollution, biodiversity protection, work ethics, health, worker safety and other ESG factors.

To achieve and maintain the principles of environmental, social and governance sustainability, an appropriate checklist must be implemented:

- Has the company embraced an environmental policy with clear commitments and constant monitoring?
- Has the organization directed management and employees to determine and design environmental policies?
- Are environmental policies continuously monitored and improved?
- What actions are taken to ensure health and safety in the workplace?
- Have policies and standards for respecting diversity and preventing discrimination been determined?
- Have employees and managers been trained to follow the rules of the chosen safety policy?
- Has positive collaboration between the company and the community been promoted?
- Is the board of directors diverse and inclusive?
- Is there a committee to promote compliance with ESG criteria?
- Are there systems in place to measure ESG performance?

The checklist must be incorporated into all activities and policies that may impact the organization's sustainable change.

In particular, he/she must work with the organization's various departments to ensure that ESG policies and strategies are integrated into decision-making processes and projects to ensure strategic alignment and monitoring of progress. He/she must contribute to the creation, enhancement, and dissemination of a sustainable culture, communicate transparently and regularly on the impact of progress towards sustainability goals within the project and the company, propose and implement sustainability-related initiatives to increase awareness and accountability of his/her team. Finally, the PM must strengthen the link between internal and external communication, creating connections between different stakeholders.

For PM and project implementation this is a radical change, but what does this mean for companies?

Analysing the responsibilities of the PM as described above, it becomes clear that those organizations that cannot afford a specialized managerial figure dedicated to the topic of sustainability must rely on their PM, who will have to:

- indicate guidelines for behaviour and cultural change whereby trust autonomy, delegation and freedom become the basis for building a new working relationship.
- employ new technologies to overcome obstacles and manage information to always make it accessible.
- support the acquisition of new knowledge and skills in order to do their own job by applying ESG concepts within projects.

Ultimately, PMs, in order to be able to implement sustainable projects consistent with corporate policies and ESG criteria, should possess skills that are complementary and evolving to the role, otherwise they risk 'Green Wishing', i.e., how PMs would like to but are not able to because they lack adequate training that would lead them to apply these criteria with confidence, ease and involvement.

Therefore, as the survey also shows, there is a need to provide companies with ongoing training paths that are as modular and PM-specific as possible, promoting structured methods to align company policies with an ongoing execution roadmap, so as to track performance against strategies, objectives, costs, human resources, investments, and results. Training must relate to artificial intelligence and automation, learning through the introduction of innovative management tools that are at the same time agile in terms of application such as:

management software, dashboards, data aggregator and reporting platforms, but also AI and automation devices.

Lastly, but very important is the synergy/connection between figures specialized in the implementation of a sustainable strategy and project teams. Here again, the figures who play a major role in the conception of a medium/long-term sustainability strategy must raise awareness and increase techniques and working methods to combine the strategy with project objectives and activities.

Otherwise, there is a risk that the PM will only define environmental and short-term aspects, losing the vision of an overall design in a sustainable sense and trespassing into greenwashing.

Therefore, looking to the future, the knowledge and competence to achieve ESG objectives will be indispensable in the project manager's operational activity, which will become increasingly centred on the development of adaptive organizations.

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Knowledge Based Frameworks and Approaches for Leading Businesses in VUCA Times: The Impact of Positivity in Multi Business Model Innovation in a World of VUCA - How Can Positive Emotions Stimulate the MBMI Process Influenced by VUCA Events?

Peter Lindgren*

Department of Business Development and Technology
Aarhus University
Birk Centerpark 15, DK-7400 Herning Denmark

Jane Flarup

Department of Business Development and Technology
Aarhus University
Birk Centerpark 15, DK-7400 Herning Denmark

* *Corresponding author*

Abstract

The importance of right speed, effectiveness, efficiency and learning in Multi Business Model Innovation (MBMI) is vital to meet today's Volatile, Uncertainty, Complex and Ambiguous (VUCA) challenges to survive as a business in Business Model Ecosystems (BMES). VUCA events coursed by external and internal sources make some of the big challenges in 2023 to businesses.

How can businesses under these "VUCA World conditions" do high quality MBMI and knowledge management? How is it possible to stay positive and influence MBMI participants and teams in these processes to be and stay optimistic, create and capture knowledge - to increase their MBMI output, performance, competence, capability and courageous appetite on doing MBMI?

This paper investigates the impact between a positive mindset and knowledge innovation MBMI processes in BMES´s influenced by VUCA Events. The impact of positivity is studied in 3 MBMI cases as competences to endure challenging MBMI processes influenced by different kinds of VUCA Events. From the cases a transfer of knowledge from tacit into explicit and internalized knowledge is outlined. The involved persons demonstrate preference for socialization processes, learning in pairs and groups as learning and creating by doing. They are very easy to internalize what they have learned in the VUCA. This corresponds to the hypothesis that a positive mindset is a predictor for success in MBMI.

The research is conducted in the view of Knowledge Management, MBMI and psychological theory – particularly the concept of positivity as fundamental for better creating and increasing learning and knowledge creation – the vital "raw material" in all MBMI and especially in a VUCA world. Our research shows that individuals embedded in networks and teams and with a general mood of positivity strengthens the MBMI processes. The paper finds that knowledge about the impact of positivity is very useful in MBMI processes influenced by VUCA.

Keywords – Positivity, Knowledge Management, Multi Business Model Innovation (MBMI) process, Volatile Uncertainty Complex Ambiguous (VUCA)

Paper type – Academic paper

1 Introduction

Businesses today are challenged by a world of increasing Volatility, Uncertainty, Complexity, and influenced by Ambiguity – (VUCA) (Warren, 1985). Coronavirus pandemic, war in Ukraine, global material and resource prices, volatile and unsecure deliveries, sudden unexpected attacks and cyber attacks, global push to complex and ambiguous Circular Green Business Model transformation (Pieoroni, 2019; Bocken, 2020) make it very complex to operate and survive as a business today.

It lays a continuous pressure on change of businesses' Business Models (BM) and to keep optimism among employees, users and customers, networks and those responsible for Multi Business Model Innovation (MBMI) difficult. It increases even further compared to previous years the pressure and importance of high speed (Fine, 1999), right speed (Lindgren 2017), effectiveness, efficiency and learning in MBMI (Lindgren, 2018). VUCA gives significant challenges to Businesses BM design, reconfiguration, and development (Lorenzo, 2017).

V = Volatility means **nature and dynamics of change**, and **the nature and speed of change forces and change catalysts**. Volatility is the changing dynamic in a set of economic, environmental and social-categorization situations. The dynamic can change due to any shift in situations, whether it is economic, environmental, social, technical, biological or anything of the like. It can be triggered outside or inside the business, or in the Business Model Ecosystem (BMES) (Lindgren, 2016). It has proven to be very difficult to find the specific component that causes the change in situational economic, environmental and social-categorization (Schick, 2017) – the VUCA Event. Studies of 63 SME´s in

Greenbizz project (Greenbizz 2022; Lindgren, 2022) showed many different VUCA Events with multi-causalities.

U = Uncertainty means **lack of predictability**, **the prospects for surprise**, and the sense of awareness and understanding of issues and events. Uncertainty in MBMI projects and processes is when the availability or predictability of information is unknown. Uncertainty often occurs in volatile BMES´s that are complex in structure involving unanticipated interactions and relations that are significant in uncertainty. Uncertainty may occur in the intention to imply causation or correlation between internal business units, external business units, the MBMI project and other MBMI projects, of a social perceiver, a target user, customer, network or even employee(s). Situations occur with lack of information or lack of causation open for a fundamental uncertainty (Bodenhausen, 2009).

C = Complexity in a VUCA means **multiplex of forces**, the **confounding of issues**, **no cause-and-effect chain** and **confusion** that surrounds businesses. Complexity in MBMI refers to the degree of interconnectivity and interdependence of AS IS BM´s and the proposed change in interconnectivity and interdependence of TO BE BM´s and AS IS BM´s in multiple BMES´s, BM´s and their BM dimensions and components (Lindgren, 2018) in certain MBMI projects, MBMI tasks and/or MBMI processes.

A = Ambiguity means **haziness of reality**, the **potential for misreads**, and the **mixed meanings of conditions**; **cause-and-effect confusion**. Ambiguity in MBMI is when the general meaning of something in a MBMI project or process is unclear even when an appropriate amount of information is provided. Uncertainty refers to relevant information in a MBMI project or process is unavailable, whereas ambiguity occurs when information is present, but the overall reason and meaning is unknown. Both uncertainty and ambiguity exist in MBMI projects and processes. In MBMI research, the concept of ambiguity determines, why and how a MBMI solution has been designed, reconfigured and developed, and secondly, the research process hypotheses on details not present in order to reveal the tacit knowledge in the solution.

VUCA increases the necessity to do more collaboration, cocreation and coopetition (Brandenburger, 1996) in designing, reconfigurating and developing BM´s in opposition to how some businesses (Børsen 2021, Berlingske 2021) and even societies paradoxically react today (Intelligencer 2022, Foreign Relations 2022). This gives greater BM opportunities – but also increased possibilities to change and create BM's that can meet the challenges and request of VUCA faster

and with higher quality. This compels businesses to reconfigure, design and develop BM´s in new and different ways to survive VUCA Events. As Mike Harris (2020) said: "Lack of preparation creates business risk".

In today's BMES´s, doing MBMI right is therefore extremely difficult and only half the battle. Businesses need to execute at speed - intensely pursuing MBMI strategy with confidence and discipline as the BMES´s changes continuously" (Lindgren, 2018). Businesses must prepare themselves for tomorrow's "VUCA World" and this means continuously experimenting with new tools and new methods to do a right speed MBMI in an efficient and effective way. Lifetime of the businesses BM´s today hasty become obsolete and outdated (Lindgren, 2018).

2 VUCA and The Multi Business Model Innovation (MBMI) concept

No business is an island (Håkonson, 1989) and no BM stands alone. It is related to other BM´s (Lindgren, 2016) through tangible and intangible relations internal and external the business. The same with BMES. That is why VUCA "hits" not just on one single business and BM, but most often other BMES, Businesses, Business Units and BM´s with "high speed". The MBMI concept, proposed in 2004 (Markides, 2004), took its point of entry from the basic approach that **any business can have more BM´s** as either operating BM´s (AS IS BM) and/or BM´s under design or reconfiguration (TO BE BM) (Lindgren 2018). TO BE BM´s can also be **intangible** or even **tangible related** to AS IS BM´s and therefore it is important, especially in "VUCA Worlds", to search for the TO BE BM´s of tomorrow, even before they have been set into MBMI process.

Our hypothesis is that VUCA can hit on all 7 levels of MBMI (see figure 1):

> *On Business core business (the grey box in the centre), on BM Portfolios, BM´s, BM Dimensions, on BM Components or even on the MBMI and development process (MBMI Time).*

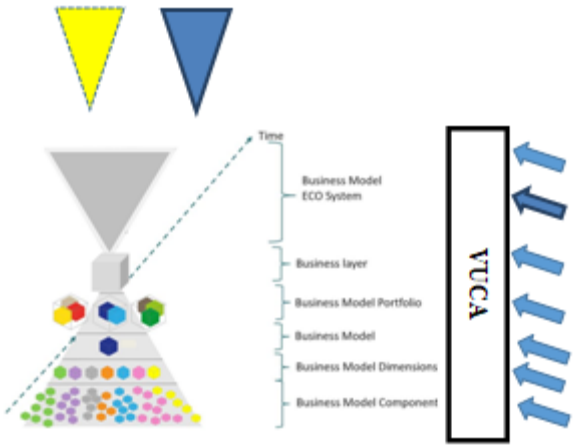


Figure 1. The 7 BM levels in BMI inspired by (Horn Rasmussen & Lindgren, 2016)

Today, MBMI processes influenced by VUCA are carried out by people. Tomorrow, it might be different (Lindgren 2021), since more MBMI projects are, in part, taken over by machines. This requires the ability to learn, create and capture knowledge faster, smarter and more sustainable. This article focus on the human beings involved in the MBMI VUCA processes.

2.1Creating and learning in VUCA

MBMI projects under influence of VUCA are demanding mental processes, and the solutions can be very controversial to standard norms, culture, trends and business practice. Our postulate is that the MBMI participants need a positive mindset, and for this purpose, positive psychology's offers insights in positive thinking even in negative situations, since research shows that positivity is fundamental prerequisite for the urge to learn and create knowledge (Knoop, 2010, 2013, 2016).

Knowledge management (Nonaka & Takeuchi, 1995) defines learning as four kinds of knowledge creating:

Table 1. Four kinds of knowledge management: tacit to explicit and explicit to renewed integrated tacit (Nonaka & Takeuchi, 1995).

	Tacit to →	**Explicit**
Tacit from ↑	**Socialization:** behaviour, peer learning by transferring of knowledge from tacit to tacit	**Externalization:** visible and distributed tacit knowledge as explicit (texts, drawings, video, checklists, whiteboard etc.)
Explicit	**Internalization:** explicit knowledge integrated into the learners as new behaviour, new competencies	**Combination:** Analysis of knowledge with other explicit knowledge (articles, reports, papers, books etc.)

In VUCA, the core information centre of learning is non-existent. Often there is no prior experience or a peer to learn from – and you have to innovate a new beginning (Cousins, 2018). Knowledge is often 'outdated', and in a leadership perspective, VUCA calls for VUCA-skills – Vision, Understanding, Clarity, Agility in order to cope with VUCA challenges (Lawrence, 2013).

This leads us to question: How to outline a competent MBMI mindset capable of coping with challenging VUCA situations. Why do some people just bring in radical and even disruptive MBMI solutions - others do not? Psychological research highlights that it is impossible to be positive, and, in the very same moment, feeling negative emotions (Fredrickson, 2009; Garland et al, 2010). In our terms, it means that it is hard to do MBMI, while the participants feel negative emotions and want to run away. Research in MBMI, shows, that happiness is a prerequisite for MBMI processes (Valter, 2018).

Psychologically, human beings flourish when they are able to handle both negativity and positivity, and not letting negative thinking take over their minds. This makes them languishing (Keyes, 2002; Seligman, 2012; Dweck, 2017). Some people are easier to enter negative thinking, and they will often see themselves caught in a sense of bad feelings and 'learned helplessness' (Seligman & Maier, 1967). This is a concept of human beings not able to act emotional freely, but are captured in negative thinking – with the result of stress, depression, low self-esteem, conflicts, anger and so forth (Garland et al, 2010; Seligman, 2012; Fredrickson, 2013a).

Below, the System Model illustrates the symbolic meaning of personal growth, well-being and motivation for learning and creating. At the top, the result of the psychological process is an increased competence in learning and increased

creativity. These achievements rely on basic well-being processes of inner motivation and a drive for personal growth, which are fundamental needs for all human beings (Knoop, 2016, Deci & Ryan, 1985).

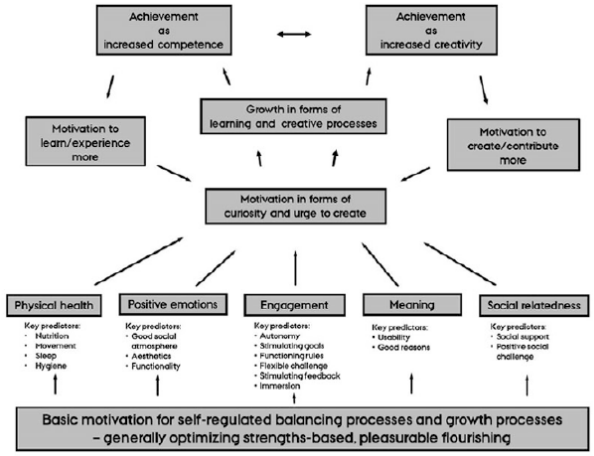


Figure 2. System's model of human flourishing (Knoop, 2016): How well-being predicts learning and creativity, which in turn predicts well-being. Physical health is omitted in our research.

3 Research Design and Research Methodology

These reflections have led us to the following:

- How do positive emotions influence MBMI and MBMI processes take place in BMES´s influenced by VUCA?
- Do the participants' mental state of positivity have an impact on MBMI success and output?

The research was designed on a mix of methods. Case 1 was studied by literature and case methods, and later, in combination with participative action research methods. The participative action research method (Chevalier, 2013; Bryman and Bell, 2011) formed the framework for case 2 and 3, since the researchers were actively involved in the MBMI process, either as participants and/or supervisors to the MBMI.

4 Cases

3 different cases were studied in 3 different BMES´s influenced by VUCA Events from 2010 to March 2023. The cases were elected out of several MBMI cases with

particular focus on characteristics of positive thinking in challenging VUCA situations.

4.1 Case 1. The Midtjyllands Airport MBMI Case

Midtjyllands Airport (MA) is located in central Denmark and is located within the Air Base Karup, which is the primary base of the Royal Danish Air Force.



Picture 1. Midtjyllands Airport

Due to its history, MA uses the runways, air traffic control, and fire department of Air Base Karup to ensure flight operation. MA is located in Jutland between 3 main competing airports; Billund Airport, Aalborg Airport and Aarhus Airport. The region around the airport is distinguished through its high number of businesses. Some of the biggest businesses in Europe have their domicile closely located to the airport. These businesses operate internationally with several departments and daughter businesses around the world. Their number of international travels per month is higher than the national average in the area. Available international flight paths are considered as crucial service for more than half of the businesses in that region. For that reason, the businesses demand short trips and day-to-day return but also long distance trips to global airport hubs in Europe. The Mayor share of all airport users is business people (80%), who travel to meetings, conferences, etc., while the minor share consists of private people (9%) and commuters (7%), who travel frequently back and forth to work, and others (4%) (Midtjyllands Airport, 2019)

4.1.1 ***MA - VUCA 1:*** *Norwegian Air stops to fly and Operator Cimber Sterling declared bankruptcy and canceled all flights on 3 May 2012*

In 2010 approximately 350.000 passengers used the MA. In autumn 2011, Norwegian announced that they would stop flying at Karup airport. Norwegian could not earn money on the route. With Norwegian's exit was Karup Airport on a

negative track road as it would lose 10 mill DKK in turnover. Without flights by Norwegian there was only Cimber Air left to service the passengers, but this stopped in May 2012, when Cimber Air went bankrupt.

MA - MBMI Solution 1:

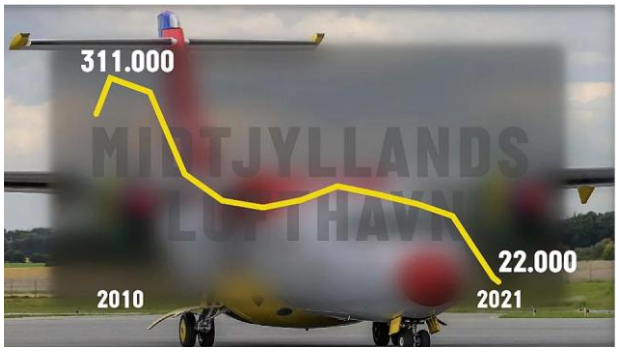
Late 2012 MA´s situation was so bad that the owners – nine municipalities around the airport - had to support with an economic help of 10 mill. DKK. It was money given to get the airport on a right track again. The airport was claimed important for the Mid and West Jutland area the Mayor of Holstebro Municipality announced. After the worst year ever since 2013 the Karup airport was again drained for money and the airport expected a deficit in 2014 of 5,8 Mio. DKK. The airport had to get another million investment and the 9 municipalities support with another 12 Mio. DKK in deficit guarantee to secure the airports survival the next 3 years.

It seemed that the investment helped and soon after Norwegian Air began again to offer cheap tickets to recruit more customers to fly from MA. The passenger number increase and the Danish DAT began to fly on March 2015 domestic flights on Karup. DAT took over the domestic root from Norwegian. The expectation was that DAT would reach about 250.000 passengers from Karup pr. year. However, MA reached a deficit of 6,1 Mio. DKK. It was needed to get up to 200.000 more passengers to balance the economy at MA. A re-branding strategy was proposed with a new name instead of Karup Airport. A promotion plan was proposed and introduced to double the number of passengers. The new name Midtjyllands Airport was decided and implemented. A new CEO was at the same time presented.

However, the change of name, promotion and CEO did not work as expected. Numbers of passengers did not increase as expected. Only 134.000 passengers flew to and from the Airport in 2018 – a decrease of 8% related to 2017. In the first half year of 2019 a further reduction of 16,5 % was realized.

4.1.2 ***MA – VUCA 2:*** *Coronavirus pandemic close the airport 2020*

In March 2020, all airports – including MA - were hit by the coronavirus pandemic. All flights to and from MA were cancelled and firstly in August 2020 reopen. A month later DAT closed their route due to coronavirus and too few passengers. Later the route opened again, but was closed in December 2020 resulting in only 29.000 passengers in 2020 – the worst year for MA ever.



Picture 2. Passenger number development in Midtjyllands Airport.

MA - MBMI Solution 2:

MA chose to close down MA and wait for new opening possibilities.

4.1.3 ***MA – VUCA 3****: Energy Prices increase 2020 - 2022*

Gas and electricity prices started to raise extremely in 2021 and 2022. This hurts MA very badly.

MBMI Solution 3:

MA began to investigate the energy consumption with 2 groups of researchers at AU – BTECH – CET and CGC. With CET they made a deep analysis of energy and a top journal on top of this work (Bujok, 2022) was created. In Greenbizz project (Greenbizz 2022) an investigation with sensors spread out on all machines and energy consuming technologies was implemented. The results of the MBMI solution was not finally gathered early 2023 but some solutions looked very positive.

4.1.4 ***MA VUCA 4:*** *Largest Customer DAT–Flight carrier announce to stop operating within 3 month*

DAT, the largest Air Flight carrier to Midtjyllands Airport, announce that it will stop operating by December 2022. Passenger drop as seen in figure 3 caused by the DAT management decision.

MBMI Solution 4:

After the coronavirus pandemic the flights were again running from MA, but the financial situation was too difficult and the deficit too high. A new board with Mayor from Viborg Municipality as chair announced a new beginning and a new strategy. The board wanted to increase the numbers of flights and make the flights/airport green. Ant the board wanted to do some new investments. MA

CEO began negotiating with a new airplane operator, but meantime the board decided to close the airport.

4.1.5 ***MA – VUCA 5****: CEO position closed down 2022*

The new MA board decided to lay the CEO of MA off and several of the employees as well.

MBMI Solution 5:

The new MA board decided to lay the CEO of MA and several of the employees off to save costs. At this moment (2022) the operators paid 142 DKK pr. passenger that travel from MA plus a start tax for the airplane and cost for the handling of passengers. Thereby MA was the most expensive airport in Denmark. By the new initiative, the board expected it would be easier to get a new operator for MA.

Table 2. Positivity, creativity, learning and relatedness in the MA-case.

VUCA Events	**Positivity**	**Creativity**	**Relatedness**	**Learning**
VUCA 1 - 5	The CEO seems very positive and has new ideas to solve the airport in collaboration with the region's largest players even though he is no longer employed at the airport.	The MA CEO takes informal meetings in his network in order to present 'crazy' solutions to the problems in the airport economy. He is highly innovative and by his creativity the airport survived longer than expected.	It seems like the CEO has an informal network of collaborator(s) outside the business with whom he finds inspiration and support to solve the VUCA.	The MA CEO learns from doing in chaos. Tacit knowledge is explicit to the public (tv, newspapers), while the CEO draws on his informal network. Even though the airport is closed, he is highly motivated to continue his task. MBMI solutions are incremental and radical (see enclosure 1).

4.2 Case 2. The Salling Autogenbrug MBMI Case

Salling Autogenbrug (SA) is a family-run business. Auto recycling is the business of scrapping, dismantling cars and other vehicles that are no longer suited for driving.

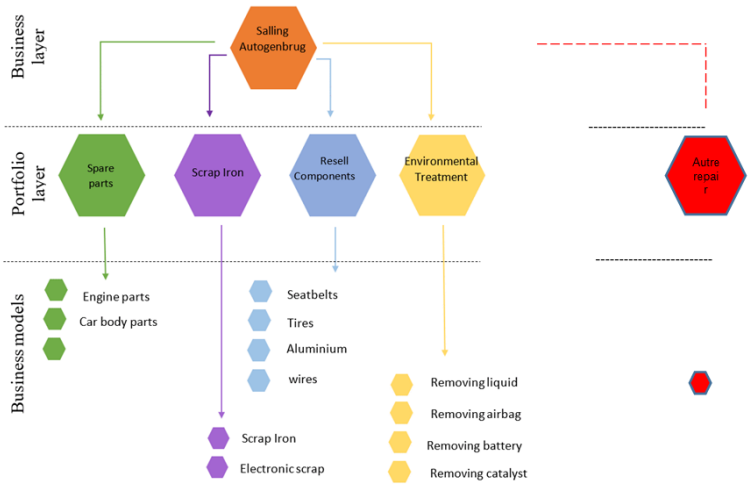


Figure 3. SA's BM portfolios.

The business models of SA can be structured in 5 main portfolios; Spare parts, Scrap Iron, Component resell, Environmental Treatment and Auto repair. All cars received at SA are today manual sorted into

- A cars – cars that can be serviced and repaired and sold as used cars
- B cars – cars that some parts can be sold for spare parts
- C cars – cars that can only be dismantle, scraped, and send for up, down or recycling

A strategic business decision was made when relocating the business so SA would no longer offer Auto repair services from 2022 as shown in the figure 4. SA at its previous location in a village in West Jutland was authorized to scrap a maximum of 10 cars at a time but SA has since then grown and today have the authorization to maximum 1500 vehicles. The SA warehouse held more than 30.000 quality controlled spare parts and the garage had a licence to do environmental treatment and dismantling. In 2009, the ownership was handed over to two sons of the founder. In 2019, the sister Lise joined the management team.

4.2.1 ***SA VUCA 1:*** *Volatile procurement prices on resources and materials, 2020 - 2022*

Prices officially and unofficially on scrapped cars turn out to increase dramatically especially in the beginning of 2019 – 2022.

MBMI Solution 1:

A new SA strategy, where management began to bulk scrapped cars and metal to take advantage of the raising prices. This hurt liquidity, but at the same time increased the income to SA due to sold cars.

4.2.2 ***SA VUCA 2****: Volatile prices on AS IS BM´s – metal, C-scrapped cars 2020 - 2022*

Prices on metal and C-scrapped cars began in early 2020 to be very volatile, especially in 2021 – 2022. This seemed to be a relation between scrap procurement prices of used cars and the prices on metal and scrapped cars. Further, the raw material prices began to show steep up-going price trends due to coronavirus pandemic and war in Ukraine.

MBMI Solution 2:

SA management immediately understood that they could get an advantage out of the price situation and began to bulk the c-scrapped cars.

4.2.3 ***SA VUCA 3:*** *Burn down of business, 2021-2022*

In February 2021 the owners met a burning platform in the most literally sense: a violent fire destroyed both a large new warehouse and one of the two garages of the SA Business.



Picture 3. The warehouse with all the spare parts burned down.

MBMI Solution 3:

Instead of rebuilding the fire-destroyed buildings, the SA management decided to move to a new location. After 4 months, a new business possibility came up. The SA management took the chance to buy a 3 times larger auto recycling business in a larger town, Skive, in West Jutland. 8 months after some heavy renovation and rebuilding, the new recycling business SA opened in March 2022.



Picture 4. The siblings, management of SA, and main entrance to the business in Skive.

The location had been rebuild into a modern auto recycling business and the revitalization of the SA business was finished. SA hereby established a new business headquarter and production with new storage perfectly fitting SA´s businesses vision and needs in short and long term perspective

4.2.4 ***SA VUCA 4:*** *New Green transformation request/ruleset – 2021 – 2023*

SA created a vision to become Denmark's most green auto recycling business of scrapped cars. However, this was a very complex strategy to fulfill, when trying to optimize green, business and social economic – triple bottom line (Ezkowiths 2008) – at the same time in a very conservative BMES. The siblings decided to increase material recycling of scrapped C - cars to a higher recycling level – from 30% to 10% "clean" related to existing standards for C-scrapped cars in the BMES. SA had for several years focused on the possibility to reuse, up, down and recycle more materials and resources from C-scrapped cars, but had not yet found a BM set-up and particular a scale-up setup that was commercially interesting and sustainable.

MBMI Solution 4:

SA together with a business consultant from network partner Business Skive (municipality organization) decided to find some funding to kick-start the MBMI project. SA together with a business consultant achieved to find the funding and started to gather a small MBMI group to solve the MBMI project Scale-up C-scrapped cars. An expert on resource and materials, a customer that schrades the C-scrapped cars and an expert on business model cases where invited to participate.

4.2.5 ***SA VUCA 5****: Volatile prices on recycling material - tires, glass, seat foam etc., 2022*

As the MBMI solution 4 began to take form SA was hit by suddenly volatile and uncertain prices on recycling materials like tire, glass, foam e.g. Instead of having positive prices on tires the prices on tire turned suddenly to a negative price – SA had to pay money "to get rid" of the tires.

MBMI Solution 5:

SA together with a network partners in MBMI 4 solution decided to find new ways new MBMI solutions, new network partners and customers to work with the materials and resources taken out of the C-scrapped cars.

4.2.6 SA and VUCA Events

Table 3. Positivity, creativity, learning and relatedness in the SA - case.

SA VUCA Event	**Positivity**	**Creativity**	**Relatedness**	**Learning**
SA VUCA 1 – 5	Moving to another site was seen as a blessing dressed like a disaster. The siblings took the challenge to renew the business' vision and the family's purpose in the local and global social life.	A 'crazy' idea of merging a very black and conservative industry with the green, climate agenda.	Rooted in family values and, in particular, the sister's passion for green energy and climate the two brothers took in the new ideas to transform the business into green. The siblings are very focused on the business' position as a local player for the region's economic and sustainable growth.	Tacit knowledge is transferred into explicit by branding the business (website, social media) with focus on socializing, externalizing and internalizing of new visions. Learning and creating from the fire is a negative destruction turned into positivity. MBMI solutions are incremental and radical (see enclosure 1).

4.3. Case 3. The DHD MBMI Case

BFB was founded in 2013 with the name NCJU, and it was hosted at the Business BV. In 2018, the name was changed to DHD and adapted as one of 18 divisions in DHD Global. DHD did basic and applied service through a global, collaborative, cross-/interdisciplinary research and business network. DHD had 4 business portfolios as seen in figure 7.

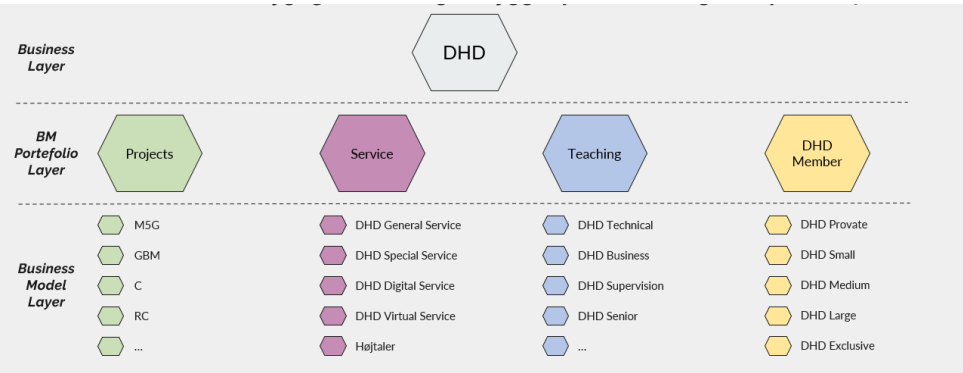


Figure 4. The DHD's BM portfolios.

DHD facilitated the headquarter of DHD, and have more than 10 cross-/interdisciplinary projects. DHD was at December 2022 involved in projects for about 3 Mio. EUR and had an internal turnover of 1 Mio. EUR pr. year. DHD had 30 employees engaged.

DHD was organized on the roots of JG, established in 2003, and JDI, established in 2008. JG and JDI both gained through 2003 – 2014 some very large projects and it was therefore natural to merge JG and JDI together, as their businesses were complimenting each other on service, projects, funding activities, conferences, education, industry collaboration and many other areas.

*4.3.1 **DHD – VUCA 1**: CEO JG not to be continued employed – 2013/2014*

In 2013, it was announced unexpectedly to CEO JG that his contract as CEO would not be prolonged.

MBMI Solution 1:

However, CEO JG wanted to continue his task, and in 2014 he was offered a joint full time CEO in DHD together with former CEO JDI. A split CEO position. DHD head office at the same time moved the residence of BV.

*4.3.2 **DHD – VUCA 2**: Internal competition begins between business units at BV, 2016 - 2022*

Internal business units within BV started to compete with DHD and tried to eliminate and prevent DHD to have general business activities – these are mandatory service activities in BV – and to forbid DHD to get into strategic important service activities, management positions and internal investments possibilities as well. The background was some old rivalry from a 2013 MBMI

process. DHD started to lose influence internal BV and to lose management positions at BV. A new manager was elected to BV and the former manager of BV service activities was reelected to service management positions. BV Management soon take over management and service positions held by DHD previously.

MBMI Solution 2:

DHD began to negotiate with BV management but without success. DHD began to search for other service activities internal BV and external BV both in a national and an international scale.

4.3.3 ***DHD – VUCA 3****: Internal split DHD - business unit*

One minor fraction of the DHD group started in 2018 to negotiate secretly with BV management aiming to break out of DHD and establish a new business unit. Several internal meetings with top management resulted in a final decision to split the DHD into two - DBD and DHD both physically and business wise**.**

MBMI Solution 3:

DHD moved to new location and began to brand DHD division heavily externally. Branding internally BV was tried, but without great success, since this task was controlled by the top BV management and the central BV communication department. After several attempts, DHD decided purely to focus on global and international branding and promotion.

4.3.4 ***DHD – VUCA 4:*** *Important BM´s are taken away from DHD*

New and revised management at BV began to marginalize DHD and take over core BM´s from DHD. DHD was rejected to operate several BM´s. These BM´s challenged young DHD employees, because if they cannot operate these BM´s activities they would not be able to qualify for advancement and fixed positions in BV. Some of the employees at DHD considered leaving DHD, although they were deeply involved in many DHD projects.

MBMI Solution 4

DHD made a tender to one important BV BM service activity – GJ BM - operated by BV, which soon was rejected by the BV management. DHD began international service activities. M5G, GB and C Projects initiated these initiatives.

4.3.5 ***DHD – VUCA 5****: Close down of Business Unit*

Top Management at BV decided within 5 days in December 2022 to close down DHD with effect 1. February 2023. Arguments were not public, and there were no communication to the DHD management about the reasons. DHD did not get any official information on beforehand, but unofficially information had been floating to some of the DHD employees some months before it happened. The DHD-labs closed and removed within few days by order from the BV management, while the researchers, DHD management and employees observed the break down without any information or any possibilities to intervene.

MBMI Solution 5:

DHD management started a process of analyzing the situation and tried to find positive solutions out of the VUCA. Networks and divisions were partners in this process.

4.3.6 DHD and VUCA Events

Table 4. Positivity, learning, creativity and relatedness in the DHD-case.

VUCA Events	**Positivity**	**Creativity**	**Relatedness**	**Learning**
DHD VUCA Event 1 - 5	DHD CEO´s focus on opportunities and global purpose of the DHD BM´s and collaboration with DHD divisions. Challenges over the years and the closing of the DHD division is seen as a positive and natural developlement of the DHD´s business focus issues.	Going global is a solution which implies collaboration with partners, networks, old and new colleagues including a new perspective on industry: Research is not necessarily an academic tasks but a project together with partners. New kinds of funding and competencies are developed.	DHD offers international BM´s for customers from India, Pakistan, Norway and Sweden with external funding. DHD enters new collaboration with other businesses in order to host the DHD headquarter. Some of these partners are not traditional BV and DHD business partners.	Visions, creative analysis and relationships are basic components of the chaotic history of the DHD. Each time there seems to be a solution, it is obstructed from outside. All kinds of learning in knowledge management is in use – primarily based on scientific research methods. MBMI solutions are incremental and radical plus one disruptive (see enclosure 1).

5 Findings

Results from the VUCA Events in the 3 cases are organized in accordance to concepts from the above mentioned theories: VUCA, the MBMI processes and BMES layer, the model of knowledge management, learning and creating.

In all cases the VUCA hits the core business, but in accordance to MBMI the 3 cases perform at different MBMI layers (see figure 1). In enclosure 1, it is summarised: Case 1 and case 3 act at the Business and BMES' level – case 1 in the national BMES, and case 3 in the international BMES. Case 2 works within its own Value Proposition and at costumer and user level. Case 1 and 3 focus primarily on establishing new networks. Different BMI solutions – incremental and radical – fit all cases, including a disruptive in case 3. In all cases networks – digital, virtual, physical – change rapidly and even paradigmatically, since the industrial era's understanding of relationships no longer functions in their cases.

In sense-making and knowledge management processes, the involved persons act different. In case 1, the MA CEO acts alone by tacit to tacit relying strongly on his informal network and relationships in this socialization process. In case 2, the SA management relies on family and local values in a process from tacit socialization to externalized knowledge about the VUCA. In case 3, both tacit socialization, externalization and combinations like analyses and published research in a process towards a new organizational structure globally and internationally with new partners, new academic links and new social networks.

The participants' positivity show that they constantly look for opportunities, even in chaos. None of them enters into negative and conflicting negotiation style with their business partners – on the contrary, it seems that an important business attitude is friendliness, openness, curiosity, collaboration and grid.

6 Discussion

How and why do these MBMI participants and teams react with positivity in VUCA? Secondly, how are these reactions transferred into cultural and personal learning competencies in the business – by the means of socialization, externalization and internalization. Our study is based on observations and interviews with the participants. This opens for a discussion about the validity and reliability. On the other side, the 3 cases are so 'extraordinary' and VUCA that they may open for new views on scientific methodology that corresponds VUCA. We are not yet able to define or quantify, why the participants act and behave as they

do, but by mixed methods including our own position as action researchers we can identify some tendencies (Bryman & Bell, 2011).

In doing so we use theories about learning and creating of knowledge by socialization, internalization of knowledge, externalization and combinations as important learning factors (Nonaka & Takeuchi, 1995; Knoop, 2010, 2013, 2016). Added to this, it seems that the participants are in a positive spiral of creativity and learning in networks – and not in negativity and learned helplessness (Seligman & Maier, 1967). This seems to be crucial for the outcome in the cases, which are not foolhardy. The participants stay calm and safe – alone or in teams - and act within existing frameworks of incremental and radical innovation. The issue is, what could disruption have proposed of total new solutions, though risky.

What kind of learning is observed in the processes? In general, all participants learn from the chaos they meet. Even though some of the learned knowledge is not useful and even destructive, the participants continue to look for new paths by the help of formal and informal relationships. Tacit knowledge transferred rapidly into implemented knowledge by externalization of values, relatedness and visions (case 1 and 2). In case 3 the process is more slowly and academic, as a global and international combination of knowledge transferring. This slow speed corresponds badly with the speed of VUCA. On the other side, it opens for a deeper analysis of tacit VUCA structures.

The mix of research methods used in our study is not optimal. It is a first research setup to get a preliminary understanding of VUCA and impact. Future VUCA, related to MBMI solutions and persons'/teams' handling of these, will be studied deeper in a larger case sample. An obvious discussion is, whether all VUCA Events identified in this paper really are VUCA events or additional definitions can be developed.

7 Conclusion: Relevance and contribution

VUCA Events can come and "hit" from internal and external the business. In previous VUCA literature, it seems as if VUCA Events mainly comes from outside the business. The 3 VUCA cases in this paper with in total 15 VUCA Events seem mainly to be exposed on Volatility (V), Uncertainty (U) and, secondly, on Complexity (C), whereas Ambiguity (A) is smaller. We also notice that the VUCA Events hit on different levels of the business but the events hit mostly on the BMES, BBM and BMD level – and seldom on the MBMI Process.

MBMI solutions were mainly concentrated on incremental and radical MBMI – only one example of disruption. MBMI processes to solve the VUCA challenge were carried out mainly in teams, which means that the main persons impacted by the VUCA Events made the MBMI solutions together with his or hers near networks. This contributes to the fact that the participants seemed to behave positively with a high focus on learning and creating meaningful activities out of the volatile and complex situations. Their learning competencies relied fundamentally on tacit knowledge transferred by socialization into implementation (case 1) and with some (visual, written) externalization (case 2). In case 3 we notice all phases in the knowledge management model with a strong focus on explicit knowledge by combined methods in an academic context.

The involved persons demonstrate a focused preference for socialization and relatedness in processes, learning in pairs and groups as learning and creating by doing. They are very easy to internalize what they have learned from the VUCA situations. We notice a very little focus on models, written documents and other externalized media in two of the three cases. These observations correspond to the hypothesis that positivity is a predictor for success in MBMI.

8 Further Research

In order to examine the participants' psychological profile we will add a psychometric test (Big Five) on a larger sample. As mentioned above, there are individual differences in our cases. Curiosity, openness, agreeableness, conscientiousness, creativity, disruption tolerance and motivation seem to be important personal characteristics in combination with a high IQ, which correlates positively with the ability to cope with complexity (Neisser et al, 1996; Horstmeyer, 2019; Pangaribuan et al, 2020).

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Enclosure 1

Overview of the 3 cases, their VUCA Events and MBMI Solutions

MA	**Short Text**	**V**	**U**	**C**	**A**	**Inside Business (IB)/Outside Business (OB)**	**MBMI Solution I – Incremental R – Radical D – Disruptive**	**MBMI Level BMES B BMP B BMD BMC MBMIP**	**Indiv idual**	**Teams**
MA - VUCA 1	Operator Cimber goes bancrupt		**X**			**OB**	**I**	**B/BMD**		**X**
MA - VUCA 2	Corona Pandemic close the airport	**x**	**x**	**x**	**x**	**OB**	**I**	BMES/B	**X**	
MA - VUCA 3	Energy Prices increases	**x**	**x**	**x**		**OB**	**I**	**BMES/B/BM**	**X**	
MA - VUCA 4	Largest Customer DAT – close down rute		**X**			**OB**	**R**	**B/BM**	**X**	
MA - VUCA 5	CEO position closed down		**x**	**x**	**x**	**IB**	**R**	**B**	**X**	
SA		**V**	**U**	**C**	**A**	**Inside Business(IB)/**	**MBMI Solution**	**MBMI Level BMES**	**Indiv idual**	**Teams**

						Outside Business (OB)	**I – Incremental R – Radical D – Disruptive**	**B BMP B BMD BMDCC MBMIP**		
SA-VUCA 1	Volatile Procurement Prices on AS IS BM	**x**	**x**			**OB**	**I**	**BMES/BM**	**X**	
SA-VUCA 2	Volatile sales prices on AS IS BM´s	**x**	**x**			OB	**I**	**BMES/BM**		**x**
SA-VUCA 3	Burn down of business		**x**	**x**		**IB**	**R**	**B**		**x**
SA-VUCA 4	New Green transformation request/rule set	**x**	**x**	**x**	**x**	**OB/IB**	**R**	**BMES/BMP**		**x**
SA-VUCA 5	Volatile prices on recycling material	**x**	**x**	**x**	**x**	**OB**	**R**	**BMES/B/BM/ MBMIP**		**X**
DHD		**V**	**U**	**C**	**A**	**Inside Business (IB)/Outside Business (OB)**	**MBMI Solution I – Incremental R – Radical D – Disruptive**	**MBMI Level BMES B BMP BM BMD BMC MBMIP**	**Individual**	**Teams**
DHD-VUCA 1	CEO JG not to be continued employed		**x**			**IB**	**I**	**B**		**X**
DHD-VUCA 2	Internal competition begins between business units	**x**	**x**	**x**	**x**	**IB**	**I**	**B BM BMD**		**x**
DHD-VUCA 3	Internal split DHD - business unit		**X**	**X**		**IB**	**R**	**B**		**X**
DHD-VUCA 4	Important BM´s are taken away from DHD	**x**	**x**	**x**	**x**	**IB**	**R**	**B BM**		**X**

DHD-VUCA 5	Close down of Business Unit	**x**	**x**	**x**	**x**	**IB**	**D**	**B**		**x**
Total		**9**	**15**	**10**	**7**	**7 OB**	**7- I**	**6-BMES-**	**5**	**10**
						7 - IB	**7- R**	**5- B**		
						1 - Both OB/IB	***1- D***	**2-BMP**		
								8-BM		
								5- BMD		
								0-BMC		
								1-MBMIP		

New Scenarios of Integration between Building Circular Design and Heritage Materials Valorisation

Graziella Bernardo*

Department of European and Mediterranean Cultures:
Architecture, Environment and Cultural Heritage
University of Basilicata
Via Lanera, 20 - 75100 Matera (Italy)

Antonella Guida

Department of European and Mediterranean Cultures:
Architecture, Environment and Cultural Heritage
University of Basilicata
Via Lanera, 20 - 75100 Matera (Italy)

** Corresponding author*

Abstract

Durability, adaptability, and reduction and valorization of waste are the main goal of the European guidelines on circular design of building. These objectives impose a real paradigm shift in design from the current on-ff logic to a continuum building design that includes preventive and planned maintenance, deconstruction design, selective demolition and up-cycling of materials and building components. In circular design, building is conceived as an organic whole of functional parts, which in turn can be broken down into construction materials. The integrated methodology of BIM and the Material Passport (BIM-MP) is the emerging digital tool both in the perspective of circular design and in the context of the sustainability of heritage conservation interventions.

The digitalization of information with the support of BIM-MP tool enables the creation a digital passport for the construction and for single materials. It allows the construction modelling at different scales of detail, from individual components down to materials. The digital passport reports as generalities the initial performance characteristics and updates them during the whole life cycle by making "visas" that indicate transformations and variations of functions and performances. It gives an identity to each component of the construction, which at the end of its life becomes a repository of materials, opening urban mining scenarios that safeguard natural resources and reduce the amount of demolition waste. The provision of a compulsory Digital Product Passport in the European Union for building materials according to the recent Eco-design for Sustainable Products Regulation will foster the development and adoption of the BIM-MP methodology.

The recent European regulatory context and the new approach to building continuum design outline new scenarios of integration between building heritage conservation and

new construction with the emergence of a new transversal ethic of sustainability based on knowledge of materials and their circular use in construction. Circular design and building heritage conservation require the same methodological approach with the involvement of different disciplinary fields for the acquisition of a range of information at different scales of detail and different perspectives of analysis. In both cases, the deeper the knowledge of the construction and its components, the greater the possibility of prolonging its life and regenerating its value. Digital tools allow sharing skills and expertise, given the possibility of effectively managing and bringing together roles and professional figures that in the past worked in isolation, with little collaboration.
Circular design reformulates the connections imposed by the criterion of hic et nunc between construction and the life of materials that neither begins nor ends with their use in a building. In Italy, many buildings belonging to the built heritage are in a dilapidated state or in many cases to the state of ruins. The implementation of heritage materials passport can transform the loss of building heritage into a potential gain, going beyond the timeline and beyond the confinement of place in a continuous history of use, deconstruction and reuse. Building heritage no longer salvageable can becomes a bank of precious materials as a unique and unrepeatable testimony of cultural heritage.

Keywords – Continuum building design 1, Sustainable construction 2, Building heritage conservation 3, BIM-MP digital tools 4, Heritage Materials Passport 5.

Paper type – Academic Research Paper

1 Introduction

Construction is one of the driving sectors for the development of world economies. Unfortunately, it is also one of the production sectors with intensive energy and raw materials consumption and high generation of demolition and construction waste (Gorgolewski, 2008; Alwan et al., 2017; Hossain, 2018; Bernardo, 2022). Currently, building design ends with the completion of the construction according to an on-off logic and both construction maintenance and management of its end-of-life are postponed until later (Atta et al., 2021). Moreover, the revolutionary innovations of digital technologies are still not widespread and exploited. For all the reasons stated above, construction is one of the priority sectors in the strategic actions outlined by the European Green Deal (COM 2019). The European guidelines on circular design of building introduce new buildings requirements and indicate the digital technologies as key-strategic tools for the adoption of circular economy models in the construction sector (COM, 2020). Durability, adaptability, and reduction and valorisation of waste are the main goal of the building circular design. In circular design, building is

conceived as an organic whole of functional parts, which in turn can be broken down into construction materials. These new objectives impose a real paradigm shift in design from the current on-ff logic to a continuum building design covering preventive and planned maintenance, deconstruction design, selective demolition and up-cycling of materials and building components (Bernardo, 2021).

In the light of the new European regulatory framework, the work explores the possibilities of integration between circular construction design and cultural heritage conservation and valorisation.

2 BIM-MP tools for continuum building design

Building Information Modelling (BIM) and Materials Passport (MP) are the emerging digital tools for continuum building design and sustainable construction (Honic et al., 2019; Honic et al., 2020; Atta et al., 2021). BIM allows the management of the huge flow of information during the entire construction life cycle and the creation of Materials Passport. This latter one gives a digital identity to materials and building components, reporting all their initial generalities and updating them with 'visas' that shows their maintenance and all the function and performance changes.

The origins of the terminology Building Information Modelling date back to the seventies although its first applications occurred in the eighties. In 2018, the International Organization for Standardization (ISO) issued the first global standards "ISO 19650:2018 - Organization and digitalization of information about building and civil engineering works, including building information modelling (BIM)" that has put in order all the standards implemented at national level by providing a unique definition at international level for the exchange of data and common protocols for the sharing of information between the various operators of the construction industry (Dassori, 2020). The International Alliance for Interoperability, renamed buildingSMART in 2007, was one of the first players to set common standards. The association developed the neutral model of building data along the building life cycle named IFC (Industry Foundation Classes). It is an open format, not controlled by any house software, now used in the BIM field for the exchange of information. Even today buildingSMART is one of the reference bodies for BIM and collaborates in the drafting of ISO standards participating in

the technical committee ISO/TC59/SC12 - Organization and digitalization of information about buildings and civil engineering works.

By breaking the mold of traditional digital modelling, BIM undertakes information modelling in parallel with geometric modelling by storing data in a common data environment. Geometrical modelling in BIM has some substantial differences compared to other digital modellings (Dassori, 2020). The first one is that a BIM model does not consist of simple lines but everything that is drawn carries a multitude of information. For example, a wall drawn in BIM is not only a geometrical representation, but it also contains information about the stratigraphy, the materials used and their properties. In addition to this, the modelling is parametric and for this reason the change on a material or element is carried over into the whole model. Another relevant aspect is that from the simple 3D model in BIM it is possible to automatically extract all the graphical drawings needed to present the project (plans, elevations, details, axonometries, etc.). Moreover, seven the smallest change to the model is directly applied to all the project boards with a clear saving of time and reduction of errors.

With BIM technology, one or more models of a building are developed through parametric digitization that can support the design, construction, use, maintenance and end-of-life phases, enabling better analysis and control than manual processes. BIM design manages the entire flow of information from the concept of the construction to its end of life and enables integrated design with the management of complex and simultaneous relationships and changes in roles and operations between project teams.

In the recent scientific literature, the integrated methodology of BIM and the Material Passport (BIM-MP) is the emerging digital tool both in the perspective of circular design and in the context of the sustainability of heritage conservation interventions (Koutamanis et al (2018); BAMB 2022).

The digitalization of information with the support of BIM-MP tool enables the creation a digital passport for the construction and for single materials. It allows the construction modelling at different scales of detail, from individual components down to materials. The digital passport reports as generalities the initial performance characteristics and updates them during the whole life cycle by making "visas" that indicate transformations and variations of functions and performances. It gives an identity to each component of the construction, which at the end of its life becomes a repository of materials, opening urban mining scenarios that safeguard natural resources and reduce the amount of demolition

waste. Moreover, the development of open digital platform based on BIM-MP tools could allow the accessibility, the implementation and updating of constructions information by all stakeholders. Vertical interoperability with other digital tools, such as software for Life Cycle Assessment or structural calculations, is one of the aspects that deserve further development for a real exploitation of the potential offered by BIM-MP digital tools. Another challenge is the transparently track information to ensure the validity and property of digital data.

3 EU Digital Product Passports

Eco-design takes the complete life cycle of products into account and represents the new frontier of sustainable design. According the principles of circular economy, apply to all phases of a product's life cycle, with the aim of reducing waste and its overall environmental impact: from the sourcing and use of raw materials, which must be reusable, biodegradable, recyclable and non-toxic; to their processing in the production process and distribution, which must comply with the EU eco-design directive (Directive 2009/125/EC), in terms of energy efficiency (reduced energy consumption in the production phases) and reduced environmental impact. The raw materials and energy consumption of the product and the possibility of reuse also contribute to defining it as eco-friendly and sustainable: the product's life cycle must be extended as far as possible, through recycling and/or reuse of its components. Alternatively, the product must be biodegradable, so that it is completely within the natural cycle.

LCA (Life Cycle Assessment) methodology assess the entire life cycle of products and how they 'interact' with the environment, including the phases of pre-production (origin of materials), production, distribution, use and reuse, and final disposal. This is an internationally standardised procedure according to ISO 14040 and 14044. At the basis of the LCA logic is the system perspective that allows the complexity of the supply chain, upstream and downstream of the production process, to be understood and managed. Critical points, *hot point*, in the entire product life cycle are then identified, in order to hypothesise solutions aimed at saving and recovering energy and materials.

One of the most significant challenges of the LCA is inadequate or even lacking information transfer between different stakeholders across value chains. To overcome this limitation and enhance the traceability of products and their components, in March 2022, the European Commission has introduced the Digital

Passport of Products (DPPs) as legal requirement over the next few years in the proposal of Eco-design for Sustainable Products Regulation (COM 2022). Construction materials together with electric vehicles, industrial batteries and textiles are the priority products for the implementation of DPPs. Digital Product Passport refers to a digital profile given to an individual product including business information, its origins and authenticity, sustainability of production and all information related to its life cycle in the supply chain of circular economy. DPPs can be valuable tools for enabling quick and convenient access to and sharing of product-related information. By scanning the tag (e.g. QR code), producers, consumers, waste operators and public agencies can easily access and possibly also upload relevant and targeted information for other stakeholders. This would come with multiple benefits. For example, easy access to information could empower consumers to purchase more circular products or inform repairers on how to fix used devices.

Chapter III of the proposed regulation on the eco-design of sustainable products outlines the general and technical requirements for the creation, access and sharing of digital product passports.

DPPs must be connected to a digital data carrier in line with standard ISO/IEC 15459:2015 by means a unique identifier and the information must be open standard, machine readable, structured, searchable by any stakeholder. The specific data requirements for DPPS of each individual product category are still being defined. A consultation process with industry partners is currently underway. Indeed, the definition of the passport requires the collaboration of the entire supply chain and the definition of crucial information that could prevent a product from being wasted. In addition, one of the key issues to be resolved is the protection of information ownership rights and corporate privacy. The development of blockchain technology can be the decisive tool to ensure the disclosure and accessibility of results on the one hand and the protection of property rights and privacy on the other hand.

4 Circular economy and heritage materials valorisation

The new models of circular economy and the digital tools for sustainable construction open new scenarios and opportunities in the field of heritage conservation. According to the current scientific approach to restoration, the historical and artistic value of the construction should be preserved by preserving

the materials of which it is made according to the criteria of minimum intervention, compatibility, reversibility and recognisability. The knowledge of materials and construction techniques is only functional in maintaining the epiphany of the image of the construction, whose value remains rigidly anchored according to the criterion of *hic et nunc* to the place and time of construction (Bernardo, 2021). However, the widespread degradation of the heritage, in many cases reduced to the state of dilapidated buildings or ruins, together with the awareness of the scarcity of resources, give the materials of which the construction is made an intrinsic value that goes beyond keeping the building alive. Circular economy and continuum building design offers the possibility of a reformulation of the connections between construction and the life of materials that neither begins nor ends with their use in buildings or specific locations. The reuse of heritage materials and building components can transform the loss of construction into a potential gain, going beyond the timeline and beyond the confinement of place in a continuous history of use, deconstruction and reuse. Construction that is no longer salvageable becomes an urban quarry of materials that have an even higher value than newly produced materials as part of the tangible heritage. The circularity of materials reduces the amount of demolition rubble and promotes economies of scale based on recycling and valorisation of heritage materials. An innovative example of the up cycling of built heritage materials is the spin-off Opalis (an anagram of the word spolia) of the Belgian company Rotor DC, which created a digital inventory of materials recovered from building heritage (Rotor DC, 2022). The up cycling of heritage materials can also stimulate the creative design of new sustainable buildings. The Resourse Rows housing complex designed by architect Anders Lendager in the city of Copenhagen is one of the most striking examples. The patchwork façade of the complex was built by reusing masonry panels from the deconstruction of the industrial complex of the city's Carlsberg brewery (Fig.1).



Figure 1. Patchwork façade of the Resource Rows residential complex built with masonry panels from the deconstruction of the Carlsberg Brewery, Copenhagen, Denmark. Photo by Mikkel Strange. Source https://www.theguardian.com/cities/2020/jan/13/the-case-for-never-demolishing-another-building

Another example of up-cycling of heritage materials that deserves special mention is the C. K. Choi building of the Asian Research Institute on the campus of British Columbia University in Vancouver (Canada). The building was constructed in 1996 to a design by Matsuzaki Wright Architects and is known to be among the first green buildings in Canada to receive several awards for efficient use of resources and energy conservation. The building consists of five identical blocks with curved roofs that recall the forms of Asian architecture and large glass surfaces that provide natural light to the interior spaces (Fig. 2). In a recent paper, Susan M. Ross highlighted one of the lesser-known sustainability aspects of the C.K. Choi building design (Ross, 2020). The load-bearing structure of the solid brick and timber building was constructed entirely from recycled materials. Bricks from demolitions carried out in the city of Vancouver were used for the masonry. The timber structural elements were salvaged from the deconstruction of the adjacent 1941 Armoury building owned by the university, which once housed students during their military service. The technical characteristics and state of preservation of the wooden lattice structure of the Armoury were assessed prior to the deconstruction of the building. The results obtained from the preliminary investigation influenced the design of the C.K. Choi building, which recovered most of the wooden structural elements with a pioneering experiment of up-cycling heritage materials. The reuse of the wooden

beams of the Armoury in the construction of the Asian Research Institute also has the value of a reparation for the wrong suffered by Canadian students of Japanese origin who lost their student status with Japan's entry into World War II.



Figure 2. Building C. K. Choi of the Asian Research Institute on the Campus of British Columbia University in Vancouver (Canada)
Source: https://sppga.ubc.ca/about/core-partners/#IAR

The knowledge of built heritage materials applied to the use of new digital tools opens new frontiers in the field of research and valorisation of heritage materials. The implementation of a heritage materials passport would make it possible to register all the information that expresses both the historical value of the material as well as its original technical properties and its state of preservation for possible reuse that goes beyond keeping the material within the original construction. The heritage materials passport can make a significant contribution to the emergence of the third paradise conceived by artist Michelangelo Pistoletto (Fig. 3). The third paradise represents a third dimension of reconciliation and synergy between the natural and artificial worlds created in the industrial age with the development of technological innovations. It is a powerful tool that has considerable implications both for the preservation of the memory of the past and for the sustainable development of communities.



Figure 3. The Third Paradise. Papier-mâché artwork by Michelangelo Pistoletto. Entrance hall of the Matera University Campus, University of Basilicata.

4 Conclusions

The recent European regulatory context and the new approach to building continuum design outline new scenarios of integration between building heritage conservation and new construction with the emergence of a new transversal ethic of sustainability based on knowledge of materials and their circular use in construction. Circular design and building heritage conservation require the same methodological approach with the involvement of different disciplinary fields for the acquisition of a range of information at different scales of detail and different perspectives of analysis. In both cases, the deeper the knowledge of the construction and its components, the greater the possibility of prolonging its life and regenerating its value. Digital tools allow sharing skills and expertise, given the possibility of effectively managing and bringing together roles and professional figures that in the past worked in isolation, with little collaboration.

The BIM-MP is an important digital tool for sustainable construction as it offers the opportunity to create open digital platforms for recording all materials of a building. The provision of a compulsory Digital Product Passport in the European Union for building materials according to the recent Eco-design for Sustainable Products Regulation will foster the development and adoption of the BIM-MP methodology.

In the next future, we could devise a materials cadastre, that we called "matastre", where the registration of the material passport provides all useful information for the circular use of building materials and components.

In Italy, many buildings belonging to the built heritage are in a dilapidated state or in many cases to the state of ruins. The implementation of heritage materials passport can transform the loss of building heritage into a potential gain, going beyond the timeline and beyond the confinement of place in a continuous history of use, deconstruction and reuse. Building heritage no longer salvageable can becomes a bank of precious materials as a unique and unrepeatable testimony of cultural heritage.

Author Contributions

Conceptualization, G.B. and A.G.; methodology, G.B.; resources, G.B. and A.G.; data curation, G.B.; writing and editing, G.B ; review G.B. and A. B.; supervision, A.G. All authors have read and agreed to the published version of the manuscript.

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Personal Data and Analytics as Drivers Broadcasting Industry Transformation

Marika Iivari*

Martti Ahtisaari Institute, Oulu Business School
University of Oulu
P.O. Box 4600, 90014 University of Oulu, Finland

Timo Koivumäki

Martti Ahtisaari Institute, Oulu Business School
University of Oulu
P.O. Box 4600, 90014 University of Oulu, Finland

* *Corresponding author*

Abstract

Personal data has become one of the main sources of value in data-driven business. Personal data plays an increasingly important role in building sustainable competitive advantage but also effects both the way services are being created and provided to users as well as how they are being utilized. Business analytics, cloud computing and platform business logic are seen to emerge in the 'industry of content', I.e., audio and visual broadcasting. This study explores the platform-based business logic behind user experience centric, data-driven services and illustrates how digital convergence impacts the nature of business in the case of broadcasting industry. We further identify mass personalization as one of the key outcomes for how personal data is used to create compelling user experiences with the use of analytics.

Keywords – Personal data, analytics, mass customization, broadcasting, data-driven

Paper type – Academic Research Paper

1 Introduction

Digitalization has been considered as the single most pervasive global enabler for new business. It has affected both the way services are provided to users as well as how they are being utilized. Cloud computing, artificial intelligence (AI) and platform business logic are seen to emerge also in the "industry of content",

more commonly known as audio and visual broadcasting. Digitalization has impacted the role of customers and consumers of the services built on those enabling technologies (Xu, Kemppainen, Ahokangas and Pikkarainen, 2020). In addition to accelerating the development of enabling technologies, increase in the amount of available personal data and advancements in business analytics are creating more and more market turbulence and at the same time presenting new business opportunities, such as novel data-driven personalized offerings. Creating value to customers has for sure always been there (Bonnet and Westerman, 2021), but the elements needed to create compelling offerings and experiences have changed in digitalization. One may even claim that digitalization as a phenomenon is experienced rather than - how it has traditionally been approached - as a perceived cause (Fors, 2010). The positive effects of personalization of content and services on customers' emotional engagement and customer satisfaction have been widely reported (e.g. Pappas et al. 2014, Cheung et al., 2015, Lambillotte et al., 2022). Emotional engagement can therefore be claimed to be as essential as technology in the creation of customer experiences (Bonnet and Westerman, 2021).

With the penetration of smart mobile devices as ubiquitous platforms for prosumerism, people are transforming market participation on the personal, social, and global levels. During Covid-19 shutdowns, the role of real-time media and consumption of data peaked even further, speeding up digitalization processes in many other industries as well. As a result, the capability to adjust value creation processes and business models based on holistic customer understanding has become one of the core drivers for companies' business success and economic sustainability. The role of personal data is particularly relevant in the broadcasting industry. The change in user behavior and how people today consume both audio and visual media, impact the whole process of broadcasting, from content creation and production to management and distribution (Hirschmeier, Tilly & Beule, 2019). The role of enabling technologies in creating highly personalized interactions in real time (Bonnet and Westerman, 2021) has emerged as a dominating competitive edge, which inevitably changes the logic of both service provisioning and utilization (Pikkarainen, Koivumäki & Iivari, 2020; Cusumano, Yoffie and Gawer, 2020; Sorri, Seppänen, Still and Valkokari, 2019).

The challenge of real-time service provisioning and utilization has highlighted the need to view traditionally siloed industry contexts, such as broadcasting, from

much wider perspective – those of platforms and ecosystems. It has been argued that platform-based digital markets can alter the way companies generate and deliver value to end customers (Cennamo, 2019; Cusumano et al. 2020). The purpose of platforms thus is to "facilitate the multi-party exchange of products, which can be goods, services, or even social currency" (Sorri et al. 2019), in the creation of novel value while ensuring value capture. Data, viewed as a new renewable resource and its conversion to information and knowledge is a key game-changer for broadcasters, as broadcasters are operating with all of the aforementioned elements of platforms: utilizing audio data and digital infrastructures in the creation of engaging services for consumers. However, very little research has been conducted in the context of radio broadcasting (Hirshmeier, Tilly and Beule, 2019).

Accordingly, in order to address this gap in academic research, the research question of this study calls "*how does personal data change business logic in the broadcasting industry*?" In order to answer the research question, this conceptual study explores the logic of platform-based business behind persona data-driven services and illustrates how digital convergence, personal data and advances in analytics impact the transformation audio broadcasting business.

The rest of this study are structured as follows. First, we will review the main concepts

2 Platform business logic

Digitalization can be defined as the use of digital technologies to change a current business model and provide new revenue and value generating opportunities (Iivari, Ahokangas, Komi, Tihinen & Valtanen, 2016). Today's emerging digital technologies cover technologies such as artificial intelligence (AI), 5th generation (5G) and future 6th generation (6G) mobile network communications, cloud computing, Internet of Things (IoT), augmented (AR) and virtual reality (VR), machine learning (ML) and blockchain. These technologies are becoming increasingly converged in today's digital markets, and function as the key enablers for various types of digital platforms. McIntyre and Srinivasan (2017, p. 143) state that "platforms can be conceptualized as interfaces—often embodied in products, services, or technologies—that can serve to mediate transactions between two or more sides." Digital platforms can therefore be explained as software-based external platforms that consist of extensible

codebase of a software-based system that provides core functionalities, shared by modules that are interoperating with it and the interfaces though which they are interoperating (Ghazawneh and Hendfridsson, 2015, pp. 199; Sorri et al. (2019).

Key elements of digital platforms include data, algorithms, components and interfaces (Iivari, Ahokangas, Matinmikko-Blue and Yrjölä, 2021; Yrjölä, Ahokangas and Matinmikko-Blue, 2019b). The increasing volume of data and the power that comes from converting this data into information and knowledge has transformed contemporary business in many industries (Xu et al., 2020). Computing power has equally been turned into economic tools with algorithms operating on the raw data. Components are add-on elements that add functionalities to platforms. Interfaces, e.g. application programming interfaces, specify how platforms and components interact and exchange information via predefined and well-documented standards (Katz and Shapiro, 1994).

The challenge for the broadcasting industry alike is that the engineering tradition has placed components and interfaces either at the core or periphery of the system (Iivari et al. 2021). Iivari et al. (2021) also reviewed that modularity can decrease coordination and transaction costs across the module boundary, while interface standardization can decrease the asset specificity of modules. This modularity could be a game-changer for broadcasters, if they manage to build more user-centric mind-set, as broadcasters are operating with all of the aforementioned elements of platforms: utilizing audio data and digital infrastructures in the creation of services for consumers.

However, the business models of the broadcasting industry can equally prevent the full utilization of digital platforms and cloud-based technologies, as tradionally, audio and visual media have functioned in their separate siloes. One approach in breaking these siloes is to reconceptualize business models in platform context. For instance, Weil and Woerner (2015) proposed four types of business models in the digital context: first, a supplier model that works in a value chain of another company, second, a multi-channel model that causes firms to restructure across several digital and physical touchpoints to serve their customers, third, a modular model that builds on plug-and-play interfaces to complement their offerings, and fourth, an ecosystem model that builds a customer-centric platform to facilitate ecosystemic interaction among customers. Here, cloud technologies enable the breaking of silos and the transformation from supply chain model to both multi-channel and modular models.

The key is to build understanding on the concept and role of platforms, as the logic of business determines how to reap the benefits enabled by cloud technologies. Therefore, whenever we are discussing digital platforms, we also need to acknowledge the role of business models. As stated by Chesbrough (2010), even a mediocre technology can succeed with a great business model, but a great technology may fail if it has a poor business model. We argue that what comes to the business of content and user experience, these both have to be in line – if there is a missing file at any phase of the audio content delivery or any information is lost (Neumann & Roca, 2004), it may cause severe quality issues and even harm the brand of end user service providers. Therefore, both technical platform modularity and architecture and service modularity and architecture (Yrjölä, Ahokangas, & Matinmikko-Blue, 2019a; Yrjölä et al., 2019b) need to be considered when combining the economic and engineering viewpoints in digital platform context. Indeed, platforms in adacemic research have an inherently dualistic perspective to business (Gawer, 2014), as they comprise quite separate economic and engineering streams of literature. Within economics, platforms are viewed as two-sided or multi-sided markets that connect supply and demand, whereas in engineering they serve as modular technological designs for facilitating innovation. Digital convergence addresses how these different elements of platforms, previously held in individual silos, come together, interact and enable the creation of new kinds of products and services.

2.1 Convergence and modularity

Convergence (Xu et al., 2020) in the radio industry means that audio is no longer the only context radio broadcasters operate in, but all forms of media are coming together. This is the core of new user experience-driven services. How then convergence and platform logic enabled by the cloud then can be manifested in the broadcasting industry when technical modularity allows the back-end and front-end systems to be developed and operated separately, even by different players (Jacobides, Cennamo and Gawer, 2018). Business models as a concept can be explained though the perspectives of value proposition, creation and capture, through opportunity exploration and exploitation as well as through competitive advantage (Xu et al. 2020). The dualistic perspective to technical and service modularity and architecture can therefore be coined from the perspective of complementarity (Xu et al., 2020; Teece, 2018), where a successful user

experience in a platformic context can be considered as the successful end-result of technology and opportunity complementarities (Xu et al., 2020). Technology complementarity enables modularity from systems and interoperability perspective whereas opportunity complementarity ensures a user-centric approach to service provisioning and service modularity.

Convergence and modularity of broadcasting industry can further be analyzed by looking at the different type of services provided in the digital context. Wirtz, Schilke and Ullrich (2010) proposed four typological business models for Internet-based companies. Each of the four types of business models entail varying value propositions and revenue models: connection (e.g., wireless connectivity or a fiber) that enables interaction, content (e.g., data or information) that can be transferred over the available connections, context (e.g., search or location) that provides situational awareness of the activity in question, and commerce (e.g., marketplace and platforms) for data, information, or context over the available connectivity.

In the Internet-of-Things context, Iivari, Ahokangas, Komi, Tihinen and Valtanen (2016) have noted the roles that infrastructure and hardware, platforms and data, devices and equipment, and applications and user interfaces play for the provisioning of digital services. When applied to the context of broadcasting industry, connection is manifested in different options for breadcasters to reach their target audience and enabling interaction, whether it's via Internet streaming, satellite distribution or traditional terrestrial radio frequencies. As a technology provider for broadcasters, a key enabler of cloud technologies is that traditionally highly (closed) supply chain -driven operating models can now be divided based on the content – the end user value.

Once connection architecture or options have been reviewed, content can be run on top of it. Key questions for industry players is to determine what is the content being provided for customers to utilize that they want to transfer over the available connections? What is the needed format? As a 3rd party content provider, for example, what kind of marketplace or supply-and-demand-type platform is required to operate at the commerce level? Whether it's infrastructure and hardware, platforms and data, devices and equipment, or applications and user interfaces, they all play a role in the provisioning of digital services. The so-called 4C layered perspective on digital business models raises the question of horizontal and vertical or even oblique business models (Iivari et al. 2016, Ahokangas, Matinmikko-Blue et al. 2019). From platform perspective, these

business models can be considered as use-case specific vertical business models, service-specific horizontal business models and the mixture of both aforementioned business model concepts.

Cloud technologies have the power to be at the heart of platform-based business logic, as connectivity and connection is the backbone that everything else builds on. Cloud-based infrastructure and web-based user interface architecture, for example, enable interfaces to operate separately from playout units, which revolutionizes the way radio stations can control their on-air playout. However, it is important to note that cloud technologies are not necessary to replace all other in-house technologies, but to complement existing technical capabilities (c.f. Xu et al., 2020, Teece, 2018). By embracing the cloud as part of product or service architecture, it is possible to develop and deploy the back-end broadcast systems in a variety of public cloud, private cloud, virtual, physical, or hybrid operating models, irrespective of distribution channels (terrestrial, satellite, web-based streaming or though mobile telecommunications networks) how end users access the media content, whether though platforms or company-specific services, or how they consume media in terms of end-user devices or applications. Convergence in the broadcasting industry means that use cases can be as diverse as there needs, but they can all be based on the same modular architecture.

Furthermore, as cloud-based technologies enable full and fast rollout of remote broadcast operations even for large broadcasters without any heavy on-site infrastructure, but at the same time also enable the rise of start-ups, as access to technology know-how or resources no longer prevent the creation of meaningful user experiences. Hence, operating in platforms can become an important source of competitive advantage for new ventures. However, this requires the understanding of the previously discussed differences between technical and service modularity and how to capture this understanding and turn that into opportunities and business advantage with business models. Modularity, convergence and complementarity also ensure the ability to react fast to market changes in order to provide seamless broadcast operations, as service providers need to be able to easily create, manage, replace or change content in real-time and simultaneously plan and manage their assets for future programming. Cloud technologies can therefore ensure the actors to have all the tools easily accessible irrespective of time and location in order to provide relevant content for meaningful user experiences (Bonnet and Westerman, 2021; Hirschmeier et al.

2019). It indeed is about bringing real-time digital user experiences to both audio and visual media production.

2.2 Drivers for cloud-based operations

The role of user experience is particularly relevant in the broadcasting industry. Whether we talk about live radio shows executed from remote studios, podcasts you can listen to on-the-go or personalized radio ads, people want content they can relate to, and meaningful experiences. Content may be king, but user experience is queen. This change in user behavior and how modern people consume their media, impacts the whole process of broadcasting, from content creation and production to management and distribution. The role of technologies in creating highly personalized interactions in real time (Bonnet and Westerman, 2021) has emerged as the dominating competitive edge in many other industries as well, changing the logic of both service provisioning and utilization (Pikkarainen, Koivumäki & Iivari, 2020; Cusumano, Yoffie and Gawer, 2020; Sorri, Seppänen, Still and Valkokari, 2019).

The so called back-end technologies that enable the development of such user-centric services are often lagging in the audio and visual media industry (Hirshmeier, Tilly and Beule, 2019). The reason for this is that until recently, long purchase cycles and slow public tendering processes especially in the public broadcasting sector, have resulted in the provisioning of large broadcast IT systems, built with multi-tier, client-server configurations and fixed installations, that were heavy, time-consuming and expensive to maintain. The need to place the audio playout close to the audio infrastructure has been a must. These have prevented flexible, proactive broadcast operations and made it challenging to meet the demands of end users. The wide gap between service provisioning and utilization especially in the radio broadcasting industry has created a large contradiction in the delivery of media services to end users, as the adoption of new technologies within a single industry varies greatly even in the provisioning of a same end-user service.

The Covid-19 crisis has further highlighted the necessity to manage and control broadcast operations anywhere, whether at home, on company premises or in the field, forcing many operators to change their whole logic of operations overnight. Although the transition towards mobile rather than studio-controlled environment was already taking place, the pace of transformation was much

slower at the systems architecture point of view and technology service providers were challenged in meeting the demands of their customers. Cloud technologies and web-based architectures have been considered as an answer to the prayers for catching up with end-user and customer demands, as they move the business logic and interfaces to back-end servers and enable the use of browser-based workstations. Virtualization and cloud technologies have made dedicated servers almost obsolete, thus disrupting the old logic of doing business and technology provisioning (Irwin, 2020).

However, if user experience has then become the competitive edge in the front-end but the systems "under the hood" have not followed the digitalization bandwagon in the same pace, how can broadcasting companies ensure their business, not only survive the digitalization wave, but also prosper, in the midst of digital transformation? All these technological advances require new kinds of service-based business models, whether the players are start-ups or large media houses. This challenge of simultaneous service provisioning and utilization has highlighted the need to view traditionally siloed industry contexts from platform perspective.

3 The transforming business logic of broadcasting

The sections above brought the attention of platforming convergence from technology and service provisioning point of view. However, overall, from digitalization perspective, it is important to acknowledge that the pace of transformation is different, not only in between different industries but also in between different organizations belonging to the same industry. Based on the initial literature review conducted for this paper, it was surprising to discover that for such a highly technology-enabled industry, very little, if any, research has been done from business perspective, as also Hirshmeier et al. (2019) discussed in their research. The need for focusing more on the business approach in researching broadcasting transformation is highlighted in the literature review article by Medina, Mazaira and Alén (2022). They note that while the innovation in the broadcasters' business model has been mainly related to innovation in the value offer and innovation in the value architecture, such as offering innovation, convergence and technological development, there is a clear gap in the holistic business model research. For example, they highlight that there is a need for novel revenue model solutions which complement the emerging business

models. The need for emphasizing the business aspects is even more important as the industry is moving towards personal data driven mass-personalized offerings. This raises a question of whether digital transformation and digitalization of broadcasting technologies in fact is taken for granted both in industry and academia. Yet, digital transformation touches all aspects of modern society (Xu et al. 2020, Hirshmeier et al. 2019).

Therefore, we conceptualize the drivers of digital transformation in broadcasting two-fold. First, the pull from the market and the need to create more personalized, user experience -driven services. Second, technology providers also experience push from the business customer side in the form of changing purchasing cycles and more precise and specific demands towards real-time consumption of digital services. The role of technology provider in this context is often a double edged sword – on one side, technology providers are able to create awareness and educate on the benefits of the cloud but at the same time balance between old operating models in which most revenue is based on.

As this study is conceptual in nature, we rely on industry observations and secondary data collection of both online and print material regarding overall technology transformation (Irwin, 2020; Hirshmeier et al., 2019). Therefore, as this study explores how personal data impacts the industry's business logic transformation, the decision-making process model of AIDA was applied, as illustrated in Figure 1 below. AIDA is a marketing term and refers to awareness – interest – desire – action. This model can be utilized to explore how new service concepts and business ideas can be absorbed, as well as describe the decision-making process of broadcasters when acquiring new technologies and IT systems. Specifically, we wanted to understand the dynamics of transformation in more detail, and how the concepts of opportunity exploration and exploitation and value creation and capture evolve towards competitive advantage based on personal data-driven and user experience-driven services.

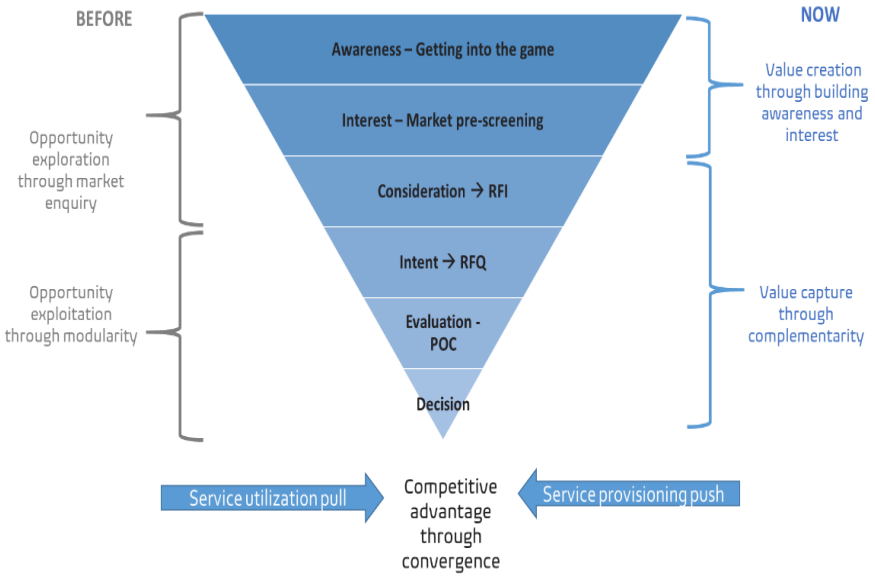

Figure 1. Illustration of broadcasting industry business logic transformation with applied AIDA framework

The traditional commercial process for acquiring technologies for media content production followed long, even one to two year purchasing and public tendering cycles. As the process was long, there was a lot of room to impact the content of specific tenders and orders after the initial contact was made. Hence, building awareness of broadcasting content production services was quite general, and the tailoring of legacy technologies and services was dominant. It was "enough" to pass the market pre-screening phase to be considered as a potential technology provider in the request for information (RFI) phase. Often, decisions for final offers (RFQ, request for quotation) were already finetuned in collaboration during the market enquiry phase, and the evaluations of the suitability of the technologies in terms of specific customer requirements and proof-of-concepts (POC) for requested services, such as talk, music, news or commercials, were already defined and evaluated during closed purchasing processes. The end process that led to final decision for broadcasting systems was then often shorter and faster. Contracts were often 10-15 years long, which meant that the agility to respond to changing consumer needs in terms of technology has been slow and difficult.

A big driver for broadcasting industry transformation has been the emergence of over-the-top (OTT) platform service providers like Spotify, Netflix, Amazon and Google, that have not only challenged the business of traditional visual broadcasters (i.e., TV and film) but also audio, i.e., radio broadcasting, as the availability of real-time content through end user devices has become mainstream medium even in cars.

Technology and service modularity, interoperability and complementarity aspects need to be tested, verified, and productized before any official decision can be made also because consumers' role as active service utilizers has equally increased as a result of real-time data. This has led to the emergence of as-a-Service type business models also in broadcasting (see e.g., Mäkilä, Järvi, Rönkkö and Nissilä, 2010; Malgoyard, 2018). However, as Hirschmeier et al. (2019, pp. 5021) revealed in their exploratory study, the general broadcasting industry is much further behind than other media industries as "the radio broadcasting industry to be in a digital paradigm shift that is similar to what happened in the music industry and the film industry 15 years ago". Therefore, understanding industry transformation is indeed two-fold, as emerging technologies, such as the cloud, and the convergence of technologies overall, have also changed broadcasting technology process up-side down. In service provisioning, companies need to be more agile, and those that have been fast to transform and embrace new technologies, have been able to respond to changing needs of the market, as the functionalities for software systems need to be demonstrated and validated with real life use cases already early on.

4 Conclusions

This paper explored how digital transformation and convergence are manifested in the context of broadcasting industry from the perspective of how personal data-driven services drive the transformation towards platforms and modularity. We conclude that the need to build more personalized services creates a simultaneous service provisioning push and utilization pull impacts the business logic of broadcasting industry especially in technology convergence, modularity and complementarity. As broadcasting industry has not been widely explored in academic research (Hirshmeier et al., 2019), in deriving the framework, general secondary data sources on the industry were gathered and used to build our analysis. Therefore, the biggest weakness of our study is its lack of empirical

grounding, but in the same vein, it offers fruitful new research avenues, especially in understanding the dynamics and transformation of traditional supply chain towards value networks.

The main theoretical implications of this research relate to the study of platforms and business models in a novel industrial context. Further on, digital transformation has widely been discussed at ecosystems level, however, a more thorough cross-industrial approach could benefit in understanding the antecedents and drivers of digital transformation. Emerging technology research highlights convergence, so how is broadcasting industry linked to other domains, such as Internet-based business and the OTTs, telecommunications and the media sector overall. Business model research highlights the role of contextualization in order to understand emergent phenomena, and unraveling the controversies and dynamics of the broadcasting industry in particular, can contribute to the discussion of platformic business models in the context of industry convergence and digitalization (Xu et al. 2020).

The practical implications of this study helps business developers and managers operating in the broadcasting industry to understand the building blocks of user experience and how they can utilize this knowledge in order to build competitive advantage for better decision making. Here, especially entrepreneurial start-ups could further seek to exploit the opportunities and capture the value of technologies by applying how the different elements of user experience can be applied in the design of those experiences, how different data sources could be utilized in improving the quality of services, pricing and revenue models and especially, how engagement to both real-time live and on-demand audio content especially can be improved as a source of competitive advantage (Bonnet & Westerman, 2021). The concept of simultaneous service utilization and provisioning directs future research towards empirical explorations both at service and service delivery network level. Personal data in this study was explored as a driver for service creation and industry transformation, however, more research is needed on how companies access, utilize and control consumer data in broadcasting services and the development of mass-customized services. These draw attention to the role of business analytics as a key enabler for these services, but also to legal and ethical concerns over personal data, such as the role of GDPR and MyData. Even though cloud technologies enable the transformation of the business logic towards user experience from technical modularity and architecture point of view, overall transition of the industry that also incorporates

the business perspective is centered around the concept of value, which comes from meaningful user experiences and emotional engagement.

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Building-up Digital Dynamic Capabilities: The Role of Collaboration Programs between Italian SMEs and University Students

Giustina Secundo

Department of Management, Finance and Technology
LUM University Giuseppe Degennaro
Casamassima BA - Italy

Ivano De Turi

Department of Management, Finance and Technology
LUM University Giuseppe Degennaro
Casamassima BA - Italy

Domenica Barile*

Department of Management, Finance and Technology
LUM University Giuseppe Degennaro
Casamassima BA - Italy

Michele Posa

Department of Management, Finance and Technology
LUM University Giuseppe Degennaro
Casamassima BA - Italy

** Corresponding author*

Abstract

Businesses must digitally transform their organizational mindset to stay competitive and gain sustainable competitive advantage. Previous studies revealed that to achieve digital transformation (DT), organizations require strategic dynamic capabilities (DC) in order to discover new opportunities, sense and measure potential threats, exploit external inputs, and deal with new digital environments.

However, the path to a complete theoretical and empirical understanding of the digital DC domain is yet in its early days. Moreover, prior research has largely concentrated on organizational DC internally, thus paying little attention to inter-organizational processes and not considering the requirement of new people for the development of the latter.

In recent years, academic research has revealed that collaborations between different parties based on the choice of specific and strategic partner are key factor for the effectiveness of the improvement process of strategic innovation capabilities. Universities, especially entrepreneurial universities, are suitable partners for the transfer of both knowledge and ideas, as well as for the development of business innovation.
Framed on these premises and based on a longitudinal case study carried out within an Italian university initiative, the goal of this study is to provide evidence that university-industry collaborations (UICs) are fruitful and key means to support and manage the exchange of stakeholders' digital knowledge within an ecosystem and to develop digital capabilities across the involved firms.
Results show that cross-border academic, industrial, and institutional interactions involve innovative and valuable processes able to develop critical DT dynamic capabilities, also suggesting empirical guidelines to educators, professors, and practitioners to structure and expand the innovation ecosystem between universities, businesses, and institutions.
This study also offers managers and SMEs practical advice on digital transformation and an empirical model to help businesses compete and improve their strategic positioning through internal process digitization and business model innovation..

Keywords – Digital Dynamic Capabilities, Digital Transformation, University-Industry Collaboration, Knowledge-Based View

Paper type – Academic Research Paper

1 Introduction

To remain competitive and develop new income streams in a world where almost everyone has access to the internet, businesses must digitally alter their operations (Teece, 2023). The use of emerging digital technologies, including as mobile, AI, the cloud, blockchain, and IoT, is known as digital transformation (DT) (Fitzgerald et al., 2013), a phenomenon that increase client satisfaction, streamline processes, and develop revolutionary company ideas and innovative business models. Therefore, digital transformation must be included in business roadmaps (Cappa et al., 2021; Vial, 2019). For this reasons, organizations need strategic capabilities to accomplish digital transformation (Nambisan et al., 2017; Nasiri et al., 2020; Teece, 2018, 2023). These capabilities are known as dynamic capabilities (DC) in the strategic management literature. Teece et al. (1997), divided dynamic capabilities into three main categories: sensing, seizing, and transforming/reconfiguring (Teece, 2007, 2023), and they represent the micro-foundations of sustainable enterprise performance and competitive advantage.

According to Teece (2023), empirical studies using DC to investigate the processes of digital transformation, have just lately acquired pace. This observation was also supported by a recent SLR done by Mele et al. (2022). However, there hasn't been enough theoretical and conceptual development in the literature on digital DC up to this point (Ghosh & Srivastava, 2022), specifically if we considered organizational routines conceptualization (Ellström et al., 2022; Teece, 2023). Additionally, the majority of research (such Warner & Wäger, 2019) concentrated mostly on large businesses, ignoring small and medium companies (SMEs) that are characterized by restricted resources to carried out a digital transformation path (Battistoni et al., 2023). Additionally, inter-organizational dynamics were not taken into account in research, according to Annarelli et al. (2021).

As stated by Teece (2023, p. 121) "new capabilities typically mean the introduction of new people". In light of this, choosing the right partner is equally crucial to the process' success (Hewitt-Dundas & Roper, 2018). Universities are excellent agents for the transmission of knowledge and ideas, as well as the creation of business innovation (Moretti, 2019; Costa et al., 2021; Secundo et al., 2017, 2019, 2020). The development of these innovative processes can be carried out through challenges and ideas competitions (de las Heras-Rosas & Herrera, 2021; Nicolajsen et al., 2019). However, despite the increasing interest on the topic, the understanding of the role of digital-oriented university-industry collaborations in improving digital transformation DC is still lacking, Furthermore, studies have been heavily focused on the advantages for businesses as a result of the ideas' quality, level of innovation, or competitive advantage (de las Heras-Rosas & Herrera, 2021), avoiding an ecosystem perspective, which is one of the novel research focuses (Costa et al., 2021).

In order to fill the abovementioned gaps, this paper answers to the following question:

> *How can collaboration programs involving SMEs and university students allow the continuous development of DC useful to manage digital transformation processes?*

The purpose of this study is to offer demonstration that university-industry collaborations (UICs) are successful and essential tools for managing the knowledge exchange between stakeholders.

The DC theory (Teece, 2007, 2023; Teece et al., 1997; Vanhaverbeke & Cloodt, 2014) serves as the theoretical framework for this study, which takes an

explorative and qualitative approach based on case study methodology (Yin, 2009). The empirical longitudinal research looks at two iterations of the Open Challege by Enterprise (OCbE) program, which was created by the LUM University Giuseppe Degennaro in collaboration with the Italian Association of Young Entrepreneurs of Confindustria Bari-BAT. By including many players from the regional university and entrepreneurial environment, the cooperation aims to support digital innovation of local Apulian SMEs.

The OCbE was established to help local firms undergoing digital transformation and business model innovation. Association managers and company owners sought help from students, academics, and researchers to address their need for innovation. The initiative resulted in the creation of a general framework centered on digital DC, which offers methodological recommendations for digital knowledge transfer in SMEs focused on innovation. Thirteen local SMEs, 146 students from two university courses, and 40 teams worked together on a total of 40 digital innovation projects during the two OCbE editions. Students and businesses may benefit from developing their digital knowledge and competencies, enhancing their skills and knowledge in DT, project management, company development, and innovation management. The project shows how cross-border connections between academia, industry, and institutions can lead to innovative and valuable procedures, and the theoretical base of the DC framework can be improved to serve as a paradigm for business schools (Teece, 2023). The research offers ideas on how to organize and broaden the innovation ecosystem between firms, institutions, and universities. Students from universities that take part in the OCbE can use their innovative ideas. Through internal process digitization and business model innovation, this study provides managers and SMEs with actionable guidance on digital transformation and an empirical methodology to aid organizations in competing and improving their strategic posture. The article is organized as follows: Section 2 contains the literature review; Section 3 describes the research methodology, Section 4 illustrates the main findings, and Section 5 presents discussions and implications of the study. Finally, the paper concludes by providing suggestions for future studies in Section 6.

2 Literature Review

2.1 Digital Transformation Capabilities

Digital technologies enable businesses to create value, develop sustainable strategic positioning, and gain a competitive advantage by understanding new segments' needs and trends. But this requires strategic capabilities to navigate digital devices and manage new digital environments. By doing so, firms can identify new possibilities, assess risks, and take advantage of disruptive technologies (Benitez et al., 2020; Nasiri et al., 2020; Vial, 2019). Additionally, businesses may integrate, reconfigure, and adapt organizational structure, resources, and internal processes to the new patterns of Industry 4.0 when they use these capabilities in a dynamic and fluid manner.

The term "dynamic capabilities" (DC) refers to a class of capabilities that are emerging as a dynamic evolution of the Resource-Based View (e.g., Penrose, 1995; Rubin, 1973) and drawn from the Schumpeterian view of innovation (Schumpeter, 1934; Teece, 2023). DC were first conceptualized by Teece et al. (1997) as special, difficult-to-replicate capabilities that allow rapid adaptability to changes in the external environment.

Teece (2007) identified three main categories of DC: sensing capabilities, seizing capabilities, and transforming activities/reconfiguring capabilities. Sensing capabilities relate to those capabilities that allow "to identify technological opportunities in the external environment"; seizing capabilities refer to "the mobilization of a company's resources to exploit these opportunities". Lastly, transforming activities/reconfiguring capabilities relate to "the continuous renewal of the organization by adapting, reconfiguring, and renewing the current resource base". The disruptive spread of the digital revolution over the past ten years has accelerated scholarly research on digital DC at both the empirical and conceptual levels (e.g., Cannas, 2021; Chirumalla, 2021; Ellström et al., 2022; Jantunen et al., 2018; Soluk & Kammerlander, 2021; Warner & Wäger, 2019; Witschel et al., 2019). To better understand the relationship between DC, business model innovation/adaptation, micro-foundations, and associated activities, Witschel et al. (2019) carried out several case studies. The authors identified 13 vital competencies, emphasizing the importance of DC as crucial and necessary enablers of business model innovation and reaffirming the strategic relevance of identifying, seizing, and altering DC to navigate environmental upheaval.

Empirical research on the digital DC development process across major incumbent enterprises in conventional sectors was conducted by Warner & Wäger (2019). The research revealed that organizational culture, collaborative strategy, and business model innovation all depend on agility as a crucial mechanism. By discovering nine sub-capabilities associated with the high-level triple domain of (1) sensing, (2) seizing, and (3) transforming, the authors also expanded the DC domain. In order, they are as follows: (1a) digital scouting; (1b) digital scenario planning; (1c) digital mentality crafting; (2a) strategic agility; (2b) rapid prototyping; (2c) balancing a digital portfolio; (3a) navigating innovation ecosystems; (3b) redisigning internal structures; and (3c) improving digital maturity.

In order to contribute to the growing understanding of DC as enablers for business model innovation, Chirumalla (2021) conducted a multiple case study on two European steel manufacturing firms. The study resulted in the development of a framework for creating digitally enabled process innovation DC (Chirumalla, 2021, p. 19).

Soluk & Kammerlander (2021), through 127 semi-structured interviews with 15 Mittlestand family firms conducted a multiple case study showing that DT consists of a three-step process: (1) process digitalization; (2) product and service digitalization, and (3) business model digitalization. The DT process involves different technologies and different necessary DT capabilities.

In order to uncover routines for sensing, seizing, and reconfiguring dynamic capacities that allow DT in businesses, Ellström et al. (2022) performed an explorative qualitative research based on in-depth interviews and focus groups. The investigation produced the six-domain categorization listed below: Inside-out digital infrastructure sensing and cross-industry digital sensing are included in the sensing dimension. Establishing corporate boundaries and developing a digital strategy are referred to as seizing. Last but not least, the reconfiguration activities are characterized as DC processes that breakdown DT into specific projects and establish a uniform digital infrastructure.

Another crucial point made by Teece (2023) is that alliances, partnerships, and other types of collaboration may close capacity gaps in companies as new capacities frequently need the addition of new employees and expertise. To successfully collaborate with other stakeholders and contribute to the creation of new ideas, concepts, and technologies, knowledge transfer and exchange are essential (Secundo et al., 2020). Furthermore, innovation is a key component in

this context (Chirumalla, 2021; Soluk and Kammerlander, 2021). The latter is carried out by integrating new digital knowledge that can enable the creation of digital organizational routines (i.e., digital dynamic capabilities); regardless of whether these steps are carried out, the output will be the digital innovation of the organization's business model (Teece, 2018). As a result, according to Osterwalder & Pigneur's (2010) concept of business model innovation, creativity can be defined as the integration of novel knowledge inputs into the current business model that enables a positive change (radical or incremental) of the latter and, as a result, the development of novel value propositions, novel business structures, processes, methods, and marketing strategies (Edison et al., 2013). In order to do this, knowledge transfer emerges as a crucial and fundamental element for the creation of digital transformation capabilities and digital business model innovation, which "requires the introduction of new people" (Teece, 2023, p. 121).

2.2 University-Industry collaborations and their role in innovation processes

In their study, Costa and Matias (2020) assert that digital transformation has significantly impacted the way businesses compete and innovate due to their limited resources and expertise in managing digital technologies. To generate digital knowledge and innovations, organizations are increasingly turning to more open and collaborative innovation mechanisms like crowdsourcing and co-creation. This aligns with the DC framework, which emphasizes outside-in processes over inside-out ones, as suggested by Teece (1997) and supported by Vanhaverbeke and Cloodt (2014).

Nevertheless, despite a number of advantages, outside-in innovation processes, i.e. innovation processes in which the source of innovative ideas can be drawn from external parties, can be impacted by a number of challenges connected to the complexity and variety of stakeholders engaged, as well as the likely presence of their conflicting interests (Czinkota et al., 2014; Kaufmann & Shams, 2016; Secundo et al., 2019, 2020).

According to various authors, including Clark et al. (2015), Ebner et al. (2009), and Secundo et al. (2017), incorporating universities and other higher education institutions as project partners can help overcome challenges faced by businesses. This approach is related to the concept of crowdsourcing (Strazzullo et al., 2022), and collaborations between universities and companies, known as

"Universities-Industry Collaborations" (UICs), are considered one of the most effective ways for businesses to improve innovation processes and gain advantages in skills and knowledge (Hurmelinna, 2022). By working together, businesses and universities can create a trust-based symbiotic win-win relationship driven by converging interests and objectives, without the potential for intra-organizational competition or opportunistic behavior (Costa et al., 2021). Moreover, the idea of the entrepreneurial university, promoted by authors such as Elia et al. (2017), Fayolle & Redford (2014), Klein & Pereira (2021), and Secundo et al. (2017), suggests that universities should pursue education, research, and institutional activities that promote social and economic development in a mutually beneficial way.

An entrepreneurial university, according to Fuster et al. (2019), is one that strongly supports the entrepreneurial activities of researchers, students, and graduates in addition to teaching and conducting research. It also has strong ties to the business community, governments, and other institutions. The academic entrepreneurship activities of entrepreneurial universities are generally acknowledged in the literature as playing a crucial role in maintaining regional growth (Miller et al., 2018). The newest types of digital academic entrepreneurship include cross-industry research initiatives, spinoff activities, and prototyping assisted by digital technology (Rippa & Secundo, 2019). Within this framework, educational curricula are revised to encourage local innovation and entrepreneurship. Building on existing partnerships with various social actors, including businesses and governments, is necessary and carried out to accomplish this goal. Among the advantages of such joint programs is an increase in the quality and quantity of data available for use in academic research, the development and improvement of students' entrepreneurship through immersion in entrepreneurial contexts, and the opportunity for universities to expand their public-private partnership network (Elia et al., 2017; Hurmelinna, 2022; Secundo et al., 2017). Companies may have access to cutting-edge scientific and technical expertise as well as the creativity and inventive ideas of young, resourceful students via university-industry partnerships. Moreover, via UICs, businesses may strengthen their innovation risk structure by sharing organizational process development with academic institutions, harnessing their specific research skills, and incorporating them into innovation initiatives and organizational enhancements (Elia et al., 2017; Fayolle & Redford, 2014; Hurmelinna, 2022; Nauwelaers, 2011; Secundo et al., 2020).

According to Secundo et al. (2020), UICs follow an outside-in strategy: the majority of projects are carried out through concept competitions or innovation challenges, through which the company innovation funnel is opened to external university expertise at the early stages of idea development and business planning. The UICs method is comprised of several phases: often, businesses articulate an innovation need or objective, followed by the inclusion of university students, professors, and university partners in the solution's creation. Universities supply knowledge, creativity, and research science, while businesses contribute their own resources, such as specialists, corporate personnel, and company premises. The process may conclude with the challenge and the selection of the best project, or it may continue with the application of the invention on the market through research and scientific initiatives. According to Hurmelinna (2022), this sort of university-firm crowdsourcing is quite new (e.g., the 2010 Idea Crossing Innovation Challenge and the ThyssenKrupp: Formula Student Germany). In the subsequent years, the trend gathered speed, accelerating the worldwide growth of projects and engaging professors and students in open business model invention competitions becoming a key source of technical innovation and economic growth has gained traction.

2.3 Research gap

According to prior research, enterprises, and organizations are required to establish organizational DT roadmaps in order to adapt to the contemporary digital environment.

Digital DC are important for strategic renewal and competitive advantage, but hard to acquire in-house due to the rapid evolution of the digital environment. External expertise and knowledge-sharing channels, such as joint innovation efforts with entrepreneurial universities, can support the development of digital knowledge. Entrepreneurial universities may play a strategic role in enabling digitally dynamic organizational capabilities within a digital innovation ecosystem involving enterprises and organizations.

Surprisingly, up to date, the literature has not still offered clear evidence of this statement. Moreover, studies on DT-DC have mostly offered abstract arguments, making it difficult for business leaders to understand what organizational measures are needed for a successful digital transformation (Ellström et al., 2022). Also, according to Teece (2023) and others (e.g., Ellström et al., 2022; Ghosh &

Srivastava, 2022), a strong lack concerns the fact that most studies investigated DC as specific managerial actions related to micro-foundations or ordinary capabilities (e.g., Warner & Wäger, 2019; Yeow et al., 2018), thus not properly investigating the DC domain as organizational routines.

Moreover, according to Annarelli et al. (2021), research have generally concentrated on organizational capacities on the inside, whereas inter-organizational processes and the significance of digital capabilities have received less attention.

The development of the DC framework necessitates more research from this viewpoint, which the current study adopts.

Finally, a significant shortcoming is the surprise neglect of small and medium companies in most research, which concentrated mostly on big organizations (e.g., Warner & Wäger, 2019) or to a very modest amount on medium firms (e.g., Ellström et al., 2022). In light of these considerations, it is vitally necessary to expand the examination of the means by which SMEs may adopt a digital transformation roadmap and create digital DC, taking into account that their limited resources might impair the efficacy of process development (Battistoni et al., 2023; Ragonnaud Guillaume, 2021).

3 Methodology

3.1 Research design

Based on these premises and through the theoretical lens of the DC theory (Teece, 2010, 2018; Teece et al., 1997; Vanhaverbeke & Cloodt, 2014), and viewing the latter as organizational routines as proposed by the most current development of the framework (e.g., Ellström et al., 2022; Kindermann et al., 2022; Teece, 2023), this research employs an exploratory, empirical, and qualitative longitudinal case study approach (Yin, 2009).

To examine new research fields (e.g., DT and DC (Mele et al., 2022)) and answer "how" and "why" research questions, "case-based exploratory methods are best suited for" (Eisenhardt, 1989; Soluk & Kammerlander, 2021, p. 7).

Based on these premises, this study empirically investigates the extent to which the digital-oriented collaborations between SMEs and entrepreneurial universities can leverage the development of enterprise's DT-DC. The unit of analysis for the present study is the enterprise.

The research approach is divided into two phases: the desk phase and the field phase. The objective of the desk phase is to examine the literature on the emergence of the DC relevant to the DT process and the collaborative mechanisms for strategic renewal. Field phase, based on direct engagement and participant observation (Yin, 2009) of the authors, intends to observe the primary processes and principles associated with the examined phenomena, in which the authors engaged as a researcher and students' tutors. The empirical and longitudinal investigation is performed through the analysis of two editions of an initiative carried out from 2020 to 2022 by the Apulian LUM University Giuseppe Degennaro in collaboration with the Italian Association of Young Entrepreneurs of Confindustria Bari-BAT, i.e., "OCbE". From 2020 to 2022, OCbE involved 13 enterprises and more than 100 students.

3.2 Data collection

Multiple methods were used to collect data to ensure triangulation (Eisenhardt, 1989) and capitalize on the synergistic effects of combining various investigative techniques and reduce the bias of a single observation in relation to multiple data use (Tarrow, 1995).

The process of data collection includes three phases. The first was characterized by the collection of primary data with the author's direct engagement in OCbE initiative. Following this, the primary outcomes of the completed projects were analyzed to extract insights and deduce conclusions regarding the process behind the growth of organizations' digital DC.

The data collection process has three phases. The first involves collecting primary data through field observations of an initiative. The second involves gathering secondary data from various sources to evaluate the project's core qualities, purpose, and objectives. The third phase is ongoing and involves conducting semi-structured in-depth interviews with key informants using a reliable and coherent methodology. The process follows six steps, including planning, creating an interview protocol, training data collectors, collecting and analyzing data, and disseminating findings.

In order to prevent a dearth of evidence, many important informants (enterprises and faculty members) were selected; informants have been and will be contected in advance of interviews.

Between February and June 2023, two interview sessions have been and will be conducted, recorded, and transcribed.

The first session was conducted between February and March 2023 with academics and faculty members; the second session round, which will be performed between May and June 2023 will include the firms' members who guided the coaching sessions of students during the project's development. Companies have been chosen among the participants of the case initiative's first and second editions..

The modalities of conduction of the interviews are planned according to the request and availability of businesses' and faculty members with a maximum duration of one hour.

Interviews include 3 open-ended questions for enterprise members and 4 open-ended questions for faculty members. The interview sample included 2 university professors and are planned to include 10 firms members that followed the team as enterprise coach.

Sampled firms have been chosen to represent the initial sample of participants in the case project. Through participation in the two final workshops of the initiative, which were respectively held on 26 May 2021 (I edition) and 25 May 2022 (II edition) at LUM University, information on the characteristics of enterprise project challenges and expected outcomes, as well as the details of the individual teams assigned to each firm, were also gathered.

3.3 Data analysis

The data collected about the case initiative have been analyzed using a three-step process following Strauss and Corbin's (1998) recommendation. The first step involved the preparation of all the data gathered through interviews with faculty members. The data have been transcribed and disaggregated, and the relevant theoretical foundation evaluated. Descriptive coding have been used to classify the data, then reduce and organise them to link the project's processes and players and their interactions with literature insights on UICs..

Data collected from interviews with company members will be analyzed using the same method as mentioned earlier. Firstly, they will be transcribed for a better organization. Secondly, a general reading of the entire set will be performed, followed by its disaggregation to identify the macro-regions of DT-DC

developed.. Finally, the data will be coded descriptively, reduced, and organized in context to arrive at the final categorization.

The organization is expected to allow the assessment of the collected evidence in terms of DT-DC into the three-aggregate dimensions and relative subdimensions drawn from the literature, respectively: (1) digital sensing capabilities, (2) digital seizing capabilities, and (3) digital reconfiguring activities for DT.

In accordance with Eisenhardt (1989), the final step of the analysis concludes with an additional series of interactions between primary and secondary data.

The ultimate goal is to design a framework that links the OCbE stages with the UICs funnel's theoretical foundations.

In addition, in accordance with the theoretical underpinnings of the advanced arguments, the study is expected to outline the connections between the latter and the development of DT-DC as organizational routines among the participating firms.

4 Findings

The OCbE, as a business innovation competition organized by the LUM University with the Italian Association of Young Entrepreneurs and local Apulian businesses, aims to promote U-I contamination, develop student entrepreneurial spirit and creativity, and foster cultural growth. The first edition focused on smart technologies, retail 2.0, and marketing and communication, while the second edition expanded to include industrial services and agri-food. Teams are evaluated using weighted technical, communication, and interaction criteria. The project involves different actors and stakeholders, including students, with various motivations for participation, such as gaining practical experience, cooperating with local enterprises, and winning a prize.

OCbE involves multiple stakeholders, including Apulian businesses, managers, university professors, LUM University, and the Italian Association of Young Entrepreneurs of Confindustria Bari-BAT.

The second and third types of stakeholders are managers and business experts who mentor innovation project development of team members. This helps Apulian businesses in improving their DT roadmaps and knowledge of digital technologies, enhancing their competitive positions, and ability to orientate themselves towards new market trends.

Students' youthful and forward-looking attitudes, along with interactions with research organizations like LUM University, motivate and provide strategic synergies for the process of business model innovation and digital transformation.

University professors, mentors and tutors facilitate student teams in participating and defining TO-BE business models and digital transformation roadmaps, while LUM University is the project sponsor and Italian Association of Young Entrepreneurs of Confindustria Bari-BAT, the partner institution. The partnership allows LUM University to strengthen its alliance with local enterprises and institutions, thus enhancing the entrepreneurial profile of the university. The program also helps to build a new entrepreneurial fabric, stimulates ideas, creativity, and business skills, and promotes digital transformation technical curricula among young people. For the Italian Association of Young Entrepreneurs of Confindustria Bari-BAT, the program provides the chance to develop strategic ties with local research institutes and embrace new types of innovation in local enterprises.

4.1 The process of Open Challenge by Enterprise

From the interviews results, it was possible to identify the process of the OCbE and the roles of the actors involved in it. The process consists of 7 steps, including a call for project, project selection, team composition, immersion, expanding, criteria selection and feedback, and prototyping.

Initially, firms are asked to participate in OCbE, after which they create project challenges for university students. University professors then announce the initiative program to the students, after which diverse groups of no more than five or six students each are formed and associated with a firm. The immersion phase follows, during which students become fully immersed in the business world of reference and understand the challenge they need to develop a digital solution for. The expanding, criteria selection and feedback, and prototyping stages follow, during which teams develop the project work and interface with entrepreneurs and experts. The teams also learn the methodological tools and procedures of business model innovation and digital transformation evaluation during their university lectures. Once the proposal has been verified, the teams move on to the prototyping phase according to university course assignments.

Through this process, students gain a deeper knowledge of digital business dynamics and how to create a digital-based business model innovation.

Teams have to undertake a series of tasks related to digital transformation evaluation and business model innovation as part of the project's execution. The teams use digital readiness and assessment tools to evaluate the organization's digital infrastructure and identify areas in need of improvement for incorporating digital innovation. They use business process modelling frameworks to map out the current and future configurations of processes that will incorporate digital innovation. Finally, a digital transformation roadmap is created based on the proposed business solution and critical KPIs to enable continuous monitoring and strategic alignment of planned results. Various tools such as Digital Maturity Model, Digital Platform Pyramid, and APQC Process Classification Framework (American Productivity & Quality Center, 2021) are utilized to execute these tasks. The Business Model Innovation dimension is simultaneously developed with the evaluation tasks for digital transformation, using business model design methodologies learned in the course. Teams use ideation techniques to resize project proposals to fit the organization's needs and infrastructures. They plot AS-IS and TO-BE business models using Design Thinking tools developed by Osterwalder & Pigneur (2010), as well as identifying new components of the nine building blocks of the Business Model Canvas. They validate their process through industry and competitive environment analysis using the Porter's 5 forces framework (1979) and the Environment Scanning Model. Teams evaluate the project outputs and the proposed business model using SWOT Analysis, the Business Model Evaluation Model, and the CSS Test.

The prototyping phase ends with teams creating mock-ups and a project portfolio, which is presented in a pitch session at LUM University in May. During the feedback phase, professors and firm members give their opinions and an external jury evaluates the project. Finally, the winning team is announced in the awarding phase.

4.3 Dynamic capabilities for digital transformation: organization perspective

The descriptive coding, reduction and organization of firm members interview results are expected to provide the identification of different routines that firms developed through and after the participation in OCbE. These are planned to be subsequently grouped into second-order themes as foundations of digital DC.

Lastly, according to the literature on DC previously analyzed in Section 2, the organization is planned to provide their inclusion into the main third-order dimensions of the DC framework.

5 Discussion and implications of the study

The case study analysis of OCbE highlights the importance of collaboration between universities and industries to develop DC for SMEs to manage DT. The initiative triggered three phases: Inspiration, Research & Ideation, and Development & Evaluation. The process involves opening corporate borders to external knowledge sources like student teams and incorporating novel models based on the constant contamination of ideas. This aligns with the conceptual arrangement of the innovation processes.

In terms of information transfer mechanisms, the findings clearly demonstrate an Outside-In approach to innovation design (Chesbrough, 2003). This is consistent with the theoretical frameworks of UICs (Secundo et al., 2019,2020; Vanhaverbeke & Cloodt, 2014).

The importance of the participation of several players from different ecoystems, such as industry, universities, and institutions, as a catalyst for the success of the process is made abundantly evident.

In light of this, OCbE can be viewed as an open and intensive innovation booster, particularly in terms of development and creation of business innovation ideas for the included organizations. One of its primary characteristics is because it was created within a research context, such as the university one, emphasizing the previously examined benefits that derive from UICs (Costa et al., 2021), and empirically applied through the convergence of three main ecosystems: industry, university and institution, respectively. In addition, it is evident that the interaction between the various players throughout the stages is crucial to the development of the final output.

Lastly, the significance of this innovative program as a methodological initiative based on the concepts of UICs in the development of sensing, seizing, and reconfiguring capabilities, thereby incorporating the theoretical references of the DC framework, is expected to be found evident. The participation of various parties in initiatives such as the one analyzed in this study can trigger the ongoing construction of those specific dynamic routines, which, according to Teece (2014, 2023), are one of the most essential resources for the creation of a

sustainable competitive advantage in an environment as volatile and unpredictable as the actual digital one.

The study contributes to existing literature on university and corporate partnerships in facilitating outside-in knowledge transfer systems (Costa & Matias, 2020). It offers empirical evidence on the role of entrepreneurial universities, such as the Apulian LUM University, in enhancing the entrepreneurial mindset and industrial innovation, leading to the social and economic development of the local community (Elia et al., 2017; Fayolle & Redford, 2014; Kuratko, 2005). The results provide valuable insights for executives and policymakers to promote social innovation and digital knowledge among SMEs, considering the limited resources they have (Battistoni et al., 2023; Ragonnaud Guillaume, 2021). The study also emphasizes the importance of establishing an entrepreneurial ecosystem involving government, local institutions, private and public organizations, universities, and research centers to foster long-term value creation for the societal community (European Commission, 2020).

6 Conclusions and suggestions for further research

As an extreme case study, there are limitations to this approach. The first may be characterized by its exploratory and case-focused nature. Future research might analyze similar projects by studying the many types of initiatives undertaken by colleges and corporations.

In addition, OCbE emphasized the deployment of business model innovation by adopting a digital innovation foundation. Additional contributions could examine comparable initiatives in different contexts, as well as in other faculty departments (engineering, IT, etc.), in order to validate the findings of this study with reference to the UIC open innovation initiatives.

Moreover, it would be beneficial to examine the long-term contribution of firms' participation in such initiatives in terms of organizational performance, innovation performance, and firms' capabilities, utilizing qualitative or mixed-method approaches, and to extend the same focus of analysis to the students involved.

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Why is it Challenging to Integrate Sustainability Performance Information into Managerial Practices of Local Governments?

Lotta-Maria Sinervo*

Tampere University
33014 Tampere University, Finland

Elina Vikstedt

Tampere University
33014 Tampere University, Finland

Mika Luhtala

Tampere University
33014 Tampere University, Finland

Harri Laihonen

University of Eastern Finland
P.O. Box 1627, 70211 Kuopio, Finland

Olga Trunova

University of Bologna
40126 Capo di Lucca 34, Bologna, Italy

* *Corresponding author*

Abstract

Local governments can have a prominent role in steering local level actions for sustainable development. To actively pursue sustainable development, local governments need to not only to generate sustainability performance information to target their actions and demonstrate their effects towards sustainability but integrate it as part of their managerial practices and consider sustainability performance information as part of their routine management and decision-making. Due to the complex and ambiguous nature of sustainability as well as institutional features of the local government organizations – and the contradictions and tensions between these two - the integration of sustainability performance information as part of managerial practices of local governments can be challenging.

We interviewed 46 key individuals who had played active roles in the integration process of sustainability performance information into the management practices of 18 different local governments in Finland and used the interview records to explore why is it challenging to integrate sustainability performance information into managerial practices in local government. Through our data, we outline five common challenges in the integration of sustainability performance information as part of the managerial practice: (1) Ambiguity and multiplicity of sustainability performance, (2) Cultural barriers and politicization of performance, (3) Siloed organizational structure and practices, (4) Unclear role of sustainability performance information, and (5) Techical difficulties in performance measurement and management

Keywords – Sustainability, Local governments, Performance information, Managerial practices

Paper type – Academic Research Paper

1 Introduction

As concerns over the state of the planet have grown, sustainability has risen as a new management objective across the sectors of society. "Global goals – Local actions" as a common catchphrase presented in sustainable development policy programmatic exemplifies the role of local-level interventions to global sustainability challenges. Although sustainability is a complex societal challenge that requires broad societal participation of all sectors, the role of local government has been identified as prominent in fostering sustainability, creating local solutions to global challenges, and in leading by example (Ball et al. 2014, Guarini et al., 2021). As sustainability is seen as an increasingly evident aim for public administration, management actions and practices assessing public policies, strategies, and actions toward sustainability are increasingly needed.

Local governments need to produce sustainability performance information to understand their own performance, identify areas of improvement, steer the implementation of national and local policies, demonstrate accountability to various stakeholders, and communicate their progress (Bebbington & Unerman, 2018; Sobkowiak, Cuckston, & Thomson, 2020; Kaur & Lodhia, 2019). Integrating sustainability performance information into the managerial practices of local governments is crucial in advancing sustainability as a new management objective and steering local-level developments towards a more sustainable future. However, previous literature displays that this is not a simple task, and several factors can hinder the deployment of new accounts as part of the

management of local government organizations. Therefore, more research on barriers and challenges in the integration of sustainability performance information as part of managerial practices is needed.

To uncover the challenges related to the integration of sustainability performance information into the managerial practices in local governments, we employ a qualitative and inductive research approach. Through a series of semi-structured interviews of sustainability specialists, financial managers, strategic managers, and branch managers representing local governments in Finland, we explore why is it challenging to integrate sustainability performance information into managerial practices in local government. Based on the content analysis of the interview records from interviews with 46 key individuals representing 18 different local governments in Finland, we outline five common challenges in the integration of sustainability performance information as part of the managerial practice: (1) Ambiguity and multiplicity of sustainability performance, (2) Cultural barriers and politicization of performance, (3) Siloed organizational structure and practices, (4) Unclear role of sustainability performance information, and (5) Technical difficulties in performance measurement and management.

This paper proceeds as follows: In the next chapter, we aim to review extant research on sustainability performance information and managerial practices in public sector organizations. In the third section, we describe our research approach and methodology. In the fourth section, we outline the five challenges in the integration of sustainability performance information based on the interview data. Finally, we discuss the results in the fifth section, present our conclusions, and provide suggestions for future research on the topic.

2 Literature background: Sustainability performance information and managerial practice

Sustainability performance commonly refers to economic, social, and environmental performance, described as "tiple-bottom-line" or "the three pillars of sustainability performance" (Purvis et al. 2019). However, there is no simple answer to what sustainability performance means in any given context (See Meadowcroft, 2007), and the term covers a range of different types of performance information such as performance in connection with natural resource conservation and emission levels; other environmental activities and initiatives; aspects of employment; occupational health and safety; community

relations; stakeholder involvement; economic impacts of the organization other than those financial measures used in the financial accounts (Adams et al., 2014).

Although, the Global Reporting Initiative (GRI 2013) states that sustainability accounting, including reporting, is a process of measuring and communicating sustainability performance and of being accountable to internal and external stakeholders for an organisation's social, environmental and economic performance, sustainability performance has not received wide academic attention. Generally, there is a stream of literature addressing the issue of sustainability in accounting. While, sustainability accounting is not the mainstream of accounting scholarship, over the years literature has grown (e.g. Kaur & Lodhia 2018). However, prior research on sustainability accounting in the public sector is limited and it is still in the early state (Greco et al. 2012). Typically, sustainability is studied from the viewpoints of accounting practices and/or reporting. These two can be seen as different parts of the same coin or as separate actions. Sustainability accounting can be understood as an information management and accounting method that provides high-quality information to demonstrate the progress of an organisation moving towards sustainability. Whereas, sustainability reporting is about formalised means of communication, aimed to disclose the organisation's sustainability performance. (Kaur & Lodhia 2018.) Main emphasis in the prior studies has been on sustainability reporting, for instance implementing different reporting standards or guidelines (e.g. Larrinaga-González & Pérez-Chamorro 2008; Vinnari & Laine 2013). Moreover, prior studies have addressed the reasons and explanations for why not to use reporting standards or guidelines and the extent of the use (Greco et al. 2012; Greco et al. 2015; Goswami & Lodhia 2013; Hossain 2018; Niemann & Hoppe 2018). For instance, Greco et al. suggest that cultural differences, such as 'power distance' and 'uncertainty avoidance', have an impact on sustainability reporting practices in local government.

Interestingly, Greiling, Traxler and Stötzer (2015) recognize the increasing emphasis of the sustainability reporting and development of those reporting practices in the public sector since the 1990's. The research of the topic seems to focus on sustainability reports as a production of information and the previously mentioned focus extent of the reporting. Thus, there seems to be a research gap in the use of sustainability performance information as a part of the managerial actions in public sector and thus local governments.

3 Methodology

To explore the question of why it is challenging to integrate sustainability performance information into managerial practices in local government, we focused on Finland as an empirical context and gathered data through semi-structured interviews of the key representatives responsible for the production and integration of sustainability performance information into the managerial practices in their organizations.

Finland provides an interesting context for the study as the local governments have a high degree of autonomy in the Finnish administrative system. Along with other Nordic countries, Finland has been a frontrunner in the promotion and implementation of various global sustainability policy programs and gained international recognition in global rankings. Furthermore, the information infrastructure in Finland is highly developed. The biggest municipalities in Finland have publicly committed to Agenda2030, and the Local Government Act (410/2015) emphasizes that municipalities must advance financial sustainability of municipal activities, advance well-being and arrange services for their residents in financially, socially and environmentally sustainable ways.

Altogether we interviewed 46 key individuals representing 18 different local governments chosen from the 25 largest municipalities in Finland. The pool of interviewees included 13 financial managers and 14 branch managers or representatives, 8 sustainability specialists, 7 strategic managers, and 2 representatives of ownership and steering, and 2 representatives of municipally owned corporations. We anticipated that the large municipalities in Finland have engaged more extensively with both the production and integration of sustainability performance information. Interviews were conducted through Teams between October 2022 and March 2023 both as individual and group interviews (2-3 interviewees). The interviews focused on questions such as how sustainability performance information is produced and to what purposes, and how is it integrated into strategic planning, budgeting, and annual reporting and as part of the managerial practices in the local governments, and what kind of managerial practices have formed around sustainability accounts. The interview data provided diverse perspectives from various managerial levels. The interview records were transcribed verbatim for analysis.

In analysing the interview transcripts, we followed interpretative approach and adopted hermeneutic analysis circle (cf. George 2021). First, the transcripts were

read by researchers individually as a whole to understand the text and its parts. Each researcher interpreted the data on their own by seeking to inductively identify the barriers and challenges of the integration of sustainability performance information as part of managerial practices of local governments. After this, we gathered to discuss our understandings of the data and develop joint categories based on our individua interpretative experiences.

4 The five challenges in the integration of sustainability performance information as part of managerial practice in local governments

Through inductive exploration, we identified five common themes related to the challenges in integrating sustainability information into managerial practices in local government: (1) Ambiguity and multiplicity of sustainability performance, (2) Cultural barriers and politicization of performance, (3) Siloed organizational structure and practices, (4) Unclear role of sustainability performance information, and (5) Technical difficulties in performance measurement and management.

4.1 Ambiguity and multiplicity of sustainability performance

Previous literature highlights the ambiguous and multiplicity of meanings that performance as a social construct often assumes (Lebas & Euske, 2006). The ambiguity and multiplicity of the interpretations of what sustainability performance stands for by different individuals across local governments were evident from the interview data. As one of the interviewees note, "it is not so clear how the concept is understood or what is meant by it." The ambiguity of the concept became visible also as an uncertainty regarding the interview themes and at times interviewees wanted to make sure that they understand sustainability in the 'right', like one interviewee puts it in the very beginning of the interview:

> *"The first thing, I ask you very quickly that I understand your point correctly, is there a definition of sustainability in this research? Is this common, all related, human well-being related and all, energy, water, food, activities, training, equality, all of this related, endurance, or? I'm sorry, I might be asking a stupid question." (Financial director)*

According to the interviewees, conceptions of sustainability within the local governments varied, and traditionally sustainability was understood narrowly as

environmental protection or against climate change, as the following extract from the interview data display:

> *"---- from the central administration point of view, and look at our city strategy, we have right, let´s say words there. But I think the definition of those words is not clear for everybody in that sense that for example one of the values we have in our strategy is" responsibility". However, I wouldn´t say that it is always there when decision-making is concerned. So, I would say that there is not a clear understanding of how we as the city… what it means to be responsible. However, in terms of this sustainability as a word, I believe that most of the decision-makers put together the words sustainability and sustainable development goals and climate work. They are the same issue for them, so they see it in a quite narrow way --- and it kind of makes it difficult, I mean it takes so much communication to make it understood at the general level in decision-making, what sustainability includes, that it has these different dimensions." (Strategic manager)*

Furthermore, the interviewees noted that there were different priorities between the performance dimensions. Several interviewees noted that economic sustainability was considered a priority in decision-making. While ecological and social sustainability were monitored, they were not given as much weight as economic performance in management. Due to the ambiguity and multiplicity of the sustainability performance at the conceptual level and varying prioritisations an understanding of the interrelations of the economic, ecological, and social dimensions of sustainability performance users could interpret performance information in various ways. The challenge from the management perspective was that "you can come up and say anything with the data quite easily" (Strategic manager). "If the members of an organization do not share the same view of performance, actions cannot be coordinated and resources may be wasted" (Lebas & Euske, 2006, p. 132).

4.2 Cultural barriers and politicization of performance

According to our data, rather than adopting international frameworks as part of performance management of sustainability, local governments focused on local strategic priorities and produced localized understandings of what sustainability as a performance objective meant for the city.

"I feel that the politicians, they don't want to use that much like different frames coming from outside as they want to do their own policy."

"I think they [focus areas] came from the strategy work. Because first they published the city strategy, which is 13 different themes and very like broad political, more like political paper. And they realized that to implement we have to prioritize. To choose something. And I think these are the themes that are the most important for the mayors. For mayor and for the deputy mayor. And maybe - I don't want to say that but, of course, it feels a little bit like there is one for every deputy mayor. Something for every deputy mayor."

"You need to look at the main organization. Why? What is the main purpose of a municipality? How should the organization work? And then you bring in these qualities or these values like sustainable development. If you make it the other way around then as this is a representative democracy with elections then these values might change, and then you drop the whole unit or the engine."

What performance information should be produced, how, and how much weight it should be given as part of the decision-making was shaped by local political agendas. The politicization of performance, according to the interviewees, was one of the challenges when key actors tried to integrate sustainability performance information as part of managerial practices, as the following extracts from the data display:

"--- it means that it [sustainability] can become a political debate before whatever elections so that right-wing parties think that this is something that the greens [Green party] do." (Strategic manager)

Due to the voluntary nature of sustainability performance information production and use in local governments and the politicization of performance, interviewees at the times experienced difficulties in their attempts to develop and introduce new performance measurement and management tools and frameworks. This work was typically done through internal working groups dedicated to sustainability programmatic, which had to be able to get the city boards and mayors to support their agenda. Interviewees stated, for example, that: "Sometimes it's difficult to take things forward to the City board" and that they are "selling this [new performance management framework] to the mayor" and "trying to create this kind of atmosphere, right atmosphere for it".

4.3 Siloed organizational structures and practices

The interviewees noted that the organisational structure of the local governments was fragmented – as one of the interviewees noted "I think it is very difficult to see us [the city] as an organization". While the central management of local governments generally considered that the branches and municipally owned companies are the best experts on their own operations, the fragmentation of conceptualisations and practices related to sustainability performance across the local government organisations made central management of sustainability performance challenging. Branch and corporate managers were influenced by sectoral programmes, rationales, and practices, and, according to the interviewees, different branches and corporations were at different stages in terms of measuring and managing their sustainability performance. Aggregating performance information from different parts of the organisation to understand the performance of the local government as a whole therefore often led to a collection of divergent descriptions of various activities conducted by different management units, which, from the management perspective, made the overall state of the progress hard to evaluate. Furthermore, as one of the interviewees stated: "when we do it [gathering of sustainability performance information] by collecting it through various people and systems it is quite a job".

Moreover, while there are official executive teams representing different branches in attempt to break the silos, there are seldom opportunities for building a shared understanding of sustainability performance information nor sustainability per se, like one of the interviewees says:

> *"In the executive team work of the municipality, during ten years of experience, I have not found myself in a situation in which we do a wide-ranging conceptual analysis [laughter] that we have defined this sustainability." (Financial director)*

Sustainability was integrated into the city strategy in many cities as a central strategic objective, but because of the siloed organisational structure and the ambiguity of sustainability as a concept in the strategic documents, the subjectivist interpretations of sustainability performance by the managers responsible for the implementation of city strategy at different parts of the organisation hindered central strategic steering and oversight. Several interviewees from the central management considered the dilemma of on the other creating a system of organization-wide oversight of the progress by

mandating the use of certain performance frameworks and metrics, and on the other hand, allowing the key actors freedom to produce performance information most relevant for them.

4.4 Unclear role of sustainability performance information

Interviewees noted that due to the complexity and multiplicity of the underlying phenomenon, the production of sustainability performance information was quite a challenge and the local governments had to rely on external information and expertise to produce new metrics and approaches. This sometimes led to the generation of sustainability performance information that was not used and had no practical implications in management, as the following extract displays:

> *"We have noticed that we have been buying in data, material, and reports a hell of a much but not using them so much. So now we have actually cut off a lot of material and data that we are that we have been using or buying or not using so much but buying anyway and now we have the set in the strategy indicators that we are following, and then we have these VLR indicators as kind of additional, separate, but it's enormously big."*

The interviewees highlighted that the local governments had both limited resources and limited capabilities in information generation, and the available resources should be used resource-wisely: Produced information should serve a clear purpose and become integrated as part of management, not exist in its own realm. In some municipalities, based on the data, it seems that sustainability performance is also interpreted through the existing information channels, or at least there is attempts to this:

> *"Of course, this economic sustainability comes through the financial statements and others quite clearly, and once we have had a separate sustainable economic programme. And, of course, when we have a budget in the process, we also have the objectives of these other pillars, so they will also be reported, the objectives that have been set. In addition, we have these welfare reports on social sustainability, and then the environmental accounts are drawn up in a certain way every year." (financial director)*

Ideally, sustainability performance information could serve multiple audiences and inform both internal and external stakeholders of the state and the progress of local governments against both local and global sustainability goals. However,

the multiple potential users of information and the lack of a clear view of who the local governments were accountable for their challenged the integration process.

4.5 Technical difficulties in performance measurement and management

In addition to above challenges, interviewees noted that producing sustainability performance information was a challenge in itself. Because the local governments had limited resources and capabilities to produce sustainability performance information, they often relayed on external experts and information sources in generating the information. In addition to fitting the indicators to work in the local contexts, the local governments had to consider what kind of indicators were possible to maintain with resources and time available. Furthermore, the choice of indicators was considered critical, as the indicator reflects the actual aim toward which managerial practices become aligned with.

- Constructing accounting object should be construction of actual performance object > Starts to shape the underlying understanding of sustainability – Performativity

5 Discussion and concluding remarks

Based on the interviews of 46 key individuals who have played active roles in the integration of sustainability performance information into the management practices of 18 different local governments in Finland, we have outlined five key interlinked challenges in the integration process stemming from the ambiguous and complex nature of the underlying phenomenon the local governments are trying to manage, and the institutional features of the local government organizations.

Firstly, sustainability is ambiguous, complex, and multidimensional concept, and therefore constructing a shared understandings of what sustainability performance means in the local context, according to the interviewees, took a lot of effort. Because local governments as organizations are not uniform and typically have various functions, establishing centralised practices was challenging. Since performance information was not mandated but voluntary, its integration as part of managerial practices and the role it should play in the decision-making could become contested, and key actors had to "make the case" for the information production and use. Due to the limited resources and capabilities, the interviewees emphasised that the sustainability performance

information that is produced needs to have true value and relevance as part of management of local government organizations, and, at its best, could serve multiple stakeholder groups simultaneously.

Our results display that sustainability performance information is not a neutral management object: Instead, we observe a recursive relationship where the local rationales shape sustainability performance and sustainability performance in turn shapes local rationales and priorities. The integration process of sustainability performance information as part of routine managerial practices of local governments is shaped not only by the institutional and organizational structures of the local governments but also by the conscious efforts of various professionals.

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Universities 3.0 as a Key Source of Digital Transformation of the Economy

Olga N. Korableva

St. Petersburg State University
7-9 Universitetskaya Embankment
St Petersburg, Russia, 199034

Oksana A. Fedorova*

St. Petersburg State University
7-9 Universitetskaya Embankment
St Petersburg, Russia, 199034

* *Corresponding author*

Abstract

Under current conditions, the development of digital technologies is largely supported by modern universities (University 3.0), which are of particular importance in the formation of digital potential. Within the framework of the presented research, the role of modern universities in achieving the goals of digitalization is considered, taking into account the current knowledge dynamics. In the context of this work, universities 3.0 refers to universities that include educational, research and an entrepreneurial functions. The entrepreneurial function is the missing link in the innovation value chain. Thanks to it, modern universities are a source of digital transformation of the economy, which is reflected in the results of the study. The emphasis on the entrepreneurial component of the universities makes it possible to reveal their role in the process of digital transformation of the economy to a greater extent.

Keywords – University 3.0, modern university, full life cycle of innovation, entrepreneurial activity, digital transformation

Paper type – Academic Research Paper

1 Introduction

Digital development occupies the leading role in the current economic priorities. In particular, this is evidenced by the global Innovation Index (GII) [World Intellectual Property Organization (WIPO), 2022], covering about 80 indicators related to infrastructure and knowledge creation in each country and the NRI (Network Readiness Index) index, characterizing the degree of readiness of the economy for digital transformations. This process, being one of the key catalysts of change, is accompanied by the introduction of unique digital technologies, the emergence of new approaches to the formation and development of knowledge, the improvement of infrastructure, the development of innovative enterprises [Goldfarb, A., Tucker, C., 2019]. Modern universities are directly involved in the presented processes, which are connected with the educational mission, the mission of research and entrepreneurship [Karpov, A. O., 2016, Secundo, G., Rippa, P., Cerchione, R., 2020].

Digital transformation is a continuous complex process that affects a significant part of companies and even goes beyond them [Vial, G., 2021]. At the same time, universities are an important part of this process in terms of creating unique digital products [Khitskov, E. A., et al 2017].

On this basis, the following hypothesis was formed: Modern universities engaged in entrepreneurial activities contribute to digitalization by participating in all links of the innovation value chain, taking into account the identification of society's priorities.

Thus, the purpose of the study is to identify the nature of the impact of entrepreneurial activity of universities on the process of digital transformation. Based on the set goal, the following tasks were solved within the framework of this study. Firstly, the analysis of the environment conditions of the innovative potential realization of modern universities were carried out. Secondly, the nature of modern universities in terms of innovation activities was studied. Thirdly, the dynamics of the strengthening of the role of universities in the context of the development of digital potential was investigated.

2 Literature review

2.1 The emergence of an entrepreneurial university and academic entrepreneurship

Throughout the existence of universities, their role has undergone a significant transformation [Redford, D. T., Fayolle, A., 2014, Carl, J., Mentor, M., 2021]. To date, there are five main types of universities, depending on their conditioned role [de Lucio, I. F., Martínez, E. C., Cegarra, F. C., Gracia, A. G., 2000], namely: academic university, classical university, social university, business university, and entrepreneurial university. In the first half of the 1980s, the concept of entrepreneurial universities became generally accepted, and thanks to works highlighting the role of higher education institutions in economic growth and social development, the topic attracted the attention of leading researchers [Rippa, P., Secundo, G., 2019].

A special contribution to the development of the theory was made by H. Etzkowitz, who introduced the term into use [Etzkowitz, H., 1983]. However, now there is still no consensus on what entrepreneurial universities are. Nevertheless, in modern research, entrepreneurial universities are most often understood as a support structure for researchers and students focused on the creation of new enterprises. After all, in addition to teaching and research functions, entrepreneurial universities are focused on the implementation of entrepreneurial projects [Duruflé, G., Hellmann, T., Wilson, K., 2018, Klofsten, M., Fayolle, A., Guerrero, M., Mia, S., Urbano, D., Wright, M., 2019]. According to the position of P. Rippaa, G. Secundo, formed on the basis of earlier works, scientific cooperation with industry, patent work, implementation of ideas in new companies, education of highly qualified specialists in the field of entrepreneurship and work with business incubators are the tools that universities use to achieve their entrepreneurial configuration [Rippa, P., Secundo, G., 2019].

Thus, the issues related to entrepreneurial universities and academic entrepreneurship are quite new in the context of modern science and require special attention. Based on the latest research presented earlier, it can be concluded that entrepreneurial universities are characterized by a special entrepreneurial function, which distinguishes it from the other types of university.

2.2 Entrepreneurial universities as a source of digital transformation

Modern digital technologies, which are represented, in particular, by the Internet of Things, Big data, Cloud and Cyber solutions, Artificial intelligence, are currently an important component of the activities of every organization, regardless of the form of ownership [Secundo, G., & Lombardi, R., 2020]. Digital technologies contribute to the transformation of innovation activities, processes and results accompanying them [Hull, C.E., Hung,Y.T.C., Hair, N., Perotti, V. and DeMartino, R., 2007, Zaheer H., Breyer, Y., Dumay, J. and Enjeti, M., 2019]. Based on the intersection of academic entrepreneurship and modern digital technologies, digital academic entrepreneurship is formed, upon which unique socio-economic and technological phenomena arise [Secundo, G., Rippa, P., & Cerchione, R., 2020].

Entrepreneurial universities, according to literary analysis, have a relationship with the process of digitalization, exerting a direct influence on it, which is reflected in several aspects [Toniolo, K., Masiero, E., Massaro, M., & Bagnoli, C., 2020]. First of all, entrepreneurial universities in the field of digital technologies are characterized by attention to the development of digital by-products and graduate startups, the formation of entrepreneurial competencies [Secundo, G., Rippa, P., & Cerchione, R., 2020], which indicates the radical impact of digital transformation on academic entrepreneurship. Secondly, universities contribute to the creation of a digital environment to stimulate digital academic entrepreneurship by providing students with necessary tools for trial activities [Garcez, A., Silva, R., & Franco, M., 2022]. Thirdly, universities are an agent of the transfer of relevant knowledge and technologies [Toniolo, K., Masiero, E., Massaro, M., & Bagnoli, C., 2020]. It also contributes to the elaboration of modern digital technologies. An integral part of the digitalization process is the entrepreneurial component aimed at the formation and development of startups, support their initiatives.

On this basis, it can be concluded that entrepreneurial universities contribute to the formation and development of digital technologies.

3 Research methodology (Data collection; data analysis)

The methods of bibliometry, collection and processing of relevant data were chosen. The criteria for selecting sources were their theoretical and practical significance, relevance, reliability, as well as objectivity. Within the framework of

the bibliometric analysis, the main sources were such resources as ScienceDirect, Emerald, SpringerLink.

The collected information is processed using statistical functions of MS Excel. The data obtained are analyzed by estimating the mean and standard deviation, ranking and calculating the correlation. Thus, the method of collecting and processing relevant statistics is necessary to confirm or refute the hypothesis that modern universities contribute to digitalization through the creation and implementation of innovative digital products.

4 Research results

Within the framework of the current study, the peculiarities of the entrepreneurial university's influence on achieving the goals of digital transformation have been identified. They are based on authoritative ratings, sustainable development strategies and individual digital transformation initiatives.

The method of bibliometric analysis occupies a special place in the research of the universities. From the academic papers published on the topic in question, the directions reflecting the research agenda were highlighted. Based on a random sample, a wide range of academic papers related to the period from 2015 to 2022 has been analyzed. All of them are presented in English and have a high citation index. Based on the results of the analysis, the keywords and research directions characteristic are demonstrated.

In particular, the analyzed academic papers trace a close relationship between entrepreneurial universities and the commercialization of knowledge. The research also highlights the role of transformation of universities under the influence of external and internal factors. The idea of commercialization of university research and the process of knowledge transfer is also emphasized in the papers of M. F. Arroyabe, M. Schumann, C. F. Arranz [Arroyabe, M. F., Schumann, M., Arranz, C. F., 2022].

The presented research directions reflect the current trends in the development of entrepreneurial universities. For instance, the keywords "Economic growth", "Knowledge", "Innovations", as well as synonymous words are most often found in studies related to 2022. They are no less typical for earlier time periods. So, in 2021, a significant part of the papers was devoted to literary analysis, technology and knowledge transfer research in the context of entrepreneurial universities.

However, the term "Entrepreneurship" is found in the keywords of the most of the analyzed papers, which suggests that entrepreneurship is one of the leading activities for this category of universities.

According to the results obtained, in 2022, a special place is given to innovation in entrepreneurial universities. Thus, in a knowledge-based economy, universities are gradually being transformed into entrepreneurial universities.

The idea is supported by the fact, that entrepreneurial universities and innovative development are very popular topics in the resent year the field of knowledge in question. Universities, according to earlier works, are part of the innovation ecosystem, building relationships with public and private organizations [Guerrero, M., Urbano, D., 2012].

The Table 1 presents the results of the bibliometric analysis, reflecting the most relevant topics in the period from 2015 to 2022, as well as the corresponding keywords identified based on the evaluation of 80 works. According to this Table, the topics change significantly from year to year, as does the object, the subject of the study, as well as the methods used in the process.

Table 1. Key research directions

Year	Research directions	Key words
2022	Entrepreneurial universities and innovational development	Economic growth, Knowledge, Innovations
2021	Transformative change in higher education	Technology and knowledge transfer, Literature review, Entrepreneurship
2020	Entrepreneurial university development	Academic entrepreneurship, Quantitative Analysis, Triple Helix, Partnership
2019	Entrepreneurial universities and strategy	Internal and External Factors, Strategy, Entrepreneurship, Third mission
2018	The entrepreneurial university as an engine for sustainable development	Academic entrepreneurship, Sustainability, University ecosystem
2017	Entrepreneurial university: a case study	Triple Helix, Higher Education, Commercialization,
2016	Entrepreneurial universities in the region	University-business Relationships; Global Universities
2015	Educational Transformation and the Role of the Entrepreneurial University	Higher Education, Academic Entrepreneur, Transformation

At the same time, digital technologies play an important role in the issues of innovation in an entrepreneurial university, as mentioned earlier [Secundo, G., & Lombardi, R.; 2020]. The relationship between entrepreneurial universities and

digitalization is reflected through statistical analysis of publicly available data. In the course of the research, a list of the leading entrepreneurial and innovative universities in the world are selected. This is largely illustrated by the data of the PitchBook analytical platform [Official website Pitchbook, 2023)], Scimago Institutions Rankings compiled on the basis of Scopus data, QS World University Rankings by Subject 2022: Computer Science and Information Systems, created with the support of Elsevier [Official website QS World University, 2022)].

According to the study the development of the entrepreneurial component reflects how many entrepreneurs study at the university, as well as the number of their companies that received the first round of venture financing in the period from January 1, 2012 to October 21, 2022. The ranking of universities by the level of development of the Computer Science and Information Systems direction largely reflects the university's contribution to the development of the digitalization process both from the training of highly qualified specialists in the IT field and from the perspective of the development of the research component. Thus, the scores presented are based on the assessment of academic reputation, the reputation of the employer and the impact of research. The bigger the sum of points, the higher the position of the university in the ranking.

To support the idea a correlation analysis of the number of company founders and the QS World University assessment in the field of Computer Science and Information Systems was carried out. The correlation coefficient is 0.63. According to the data obtained, the stronger the university is in the field of Computer Science and Information Systems, the more university graduates will become founders of start-ups or startups. On this basis, a correlation graph is presented below, visually reflecting the existing relationship between the data sets.

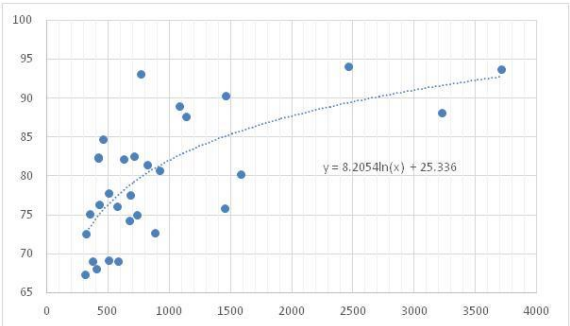

Fig.1. Correlation analysis of the number of company founders and QS World University estimates

A significant number of startups carry out their work in the digital sphere, for example, Nubank, Chime, Didi Global, DoorDash, Open AI.

Information, presented in the Table 2, allows a more holistic assessment of the role of universities in the development of digital entrepreneurship. This is the data of the PitchBook analytical platform [Official website Pitchbook, 2023)], Scimago Institutions Rankings compiled on the basis of Scopus data, QS World University Rankings by Subject 2022: Computer Science and Information Systems, created with the support of Elsevier [Official website QS World University, 2022)].

QS World University scores in the field of Computer Science and Information Systems average 79.62, which in the framework of the presented sample slightly exceeds the median value of 79 points. At the same time, the standard deviation is 7.91 points. Massachusetts Institute of Technology is a leader in Computer Science and Information Systems education (94.1 points). Also, there are 2,459 founders of companies among its graduates. In comparison with Stanford University, where 3,710 graduates have become founders of companies, the QS World University Ranking scores differ only slightly, amounting to 93.7.

The data ranked by the number of startup founders, on the basis of which the analysis was performed, are presented in the table below. The results of the analysis reflect the essential role of the entrepreneurial component in the context of the work of universities. Especially, it is characteristic of Computer Science and Information Systems field of knowledge.

Table 2. Entrepreneurial universities-leaders in the field of Computer Science and Information Systems education

University	**Founder count**	**Company count**	**QS World University Ranking: CS**
Stanford University	3710	2808	93,7
Harvard University	3222	2713	88,1
Massachusetts Institute of Technology	2459	1863	94,1
Columbia University	1586	1402	80,2
University of California, Berkeley	1459	1202	90,3
University of Pennsylvania	1456	1244	75,9
University of Cambridge	1133	939	87,6
University of Oxford	1083	905	89
New York University	923	853	80,7
University of Chicago	880	762	72,7
University of California, Los Angeles (UCLA)	818	714	81,5
Carnegie Mellon University	764	626	93,1

University of Michigan, Ann Arbor	735	613	75
Cornell University	715	595	82,5
University of Texas at Austin	678	581	77,6
University of Southern California (USC)	676	595	74,3
Imperial College London	628	526	82,2
Johns Hopkins University	582	493	69
Yale University	576	487	76,1
Duke University	508	435	69,2
University of Illinois, Urbana-Champaign	506	408	77,8
University of Toronto	462	363	84,7
Georgia Institute of Technology	431	376	76,3
Tsinghua University	421	394	82,4
University of Washington	420	346	82,3
Boston University	405	366	68,1
University of Wisconsin-Madison	376	311	69,1
University of California, San Diego	354	290	75,1
University of Maryland, College Park	322	280	72,6
Technion - Israel Institute of Technology	314	260	67,3

Thus, the relationship between the entrepreneurial potential of universities and their role in the process of digitalization was identified. The research achievements of universities, the high level of training of specialists, the reputation of the university in the field of Computer Science and Information Systems favorably affects the development of entrepreneurship, including in the field of digital technologies.

According to the goals of digitalization, it was revealed that today there is a need for universities to participate in entrepreneurial activities. Next, the paper presents an analysis of the role of universities in the process of digitalization of the economy. Modern universities have a positive impact on digital transformation, creating a basis for the development of intellectual capital, which distinguishes them from universities of older formation. So, the results obtained confirm the hypothesis put forward earlier: modern universities engaged in entrepreneurial activities contribute to digitalization by participating in all links of the value chain, taking into account the identification of society's priorities. However, there is still a debatable issue concerning the differentiation of universities and the preservation of the sustainability of innovative potential in matters of digital transformation. And it creates the basis for future research.

5 Discussions

In modern conditions, priorities in the scientific and technological sphere are considered in direct connection with the development of a long-term strategy for sustainable development [Grebenyuk, A. Yu., Pikalova, A. G., Sokolov, A.V., Shashnov, S. A., Kayvo-oya, Ya., 2016], as well as individual digital transformation initiatives [Tomičić Furjan, M., Tomičić-Pupek, K., Pihir, I., 2020]. The concepts of digital business are aimed at the elaboration of new business models, the creation of unique associations, the formation of new ecosystems, the commercialization of innovative products [Pihir, I., Tomičić-Pupek, K., Tomičić Furjan, M., 2019]. Universities 3.0 play an important role in the presented process [Carayannis, E. G., Morawska-Jancelewicz, J., 2022]. Digital transformation has a direct connection with universities in the issue of development [Tomičić Furjan, M., Tomičić-Pupek, K., Pihir, I., 2020].

The model of a modern university combines educational, research, design and innovation, socio-cultural activities of higher education, as well as entrepreneurial activities [Boehm, C., 2022]. Entrepreneurial activity through the creation of innovative digital products taking into account the needs of society is a key value, thanks to which modern universities contribute to digitalization. At the same time, there are universities, that carry out only research activities, generate knowledge and contribute to their dissemination and training of highly qualified personnel [Etzkowitz, Leydesdorff, 2000]. In the context of earlier universities' concept, their influence on the process of digital transformation is less reflected [Coskun, Y. D., 2015]. Universities are aimed at the commercialization of knowledge, but do not take into account the nature of the market, the need for a product. The entrepreneurial function is missing here. In the context of the presented hypothesis, only modern universities can influence the achievement of digitalization goals through entrepreneurship activity as a very important stagy of the whole innovation life cycle.

6 Conclusion

As a result of the study, the hypothesis had put forward was confirmed on the basis of a bibliometric analysis, as well as by evaluating the average value and standard deviation, ranking and calculating the correlation of data from the number of company founders and the QS World University assessment in the field of Computer Science and Information Systems. As a result of the analysis,

patterns of development of theoretical issues related to entrepreneurial universities were revealed, in particular, their role in the formation and development of innovative potential. Moreover, the relationship between the entrepreneurial potential of universities and the assessment of QS World University in the field of Computer Science and Information Systems is reflected.

Thus, the goal has been achieved and identification of the impact of university activities on the process of digital transformation has been revealed.

The presented results has formed the basis for future research. In accordance with the plan of future research, it was decided to study universities 3.0 in the context of particular areas of entrepreneurial activity, which can contribute to elaboration more detailed approach to the role of universities 3.0 in the process of rapid changes in the business landscape under digitalization.

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Knowledge Innovations: Research of Perspective FinTech Technologies Based on Literature Review and Patent Analysis

Olga Korableva

St. Petersburg State University,
7-9 Universitetskaya Embankment,
199034 St Petersburg, Russia,

Olga Kalimullina*

The Bonch-Bruevich Saint-Petersburg State University of Telecommunications,
1 61, letter A Embankment of the river Moika,
191186 St Petersburg, Russia

* *Corresponding author*

Abstract

COVID-19 pandemic significantly has changed the behaviour of customers and businesses, and influenced the development of technologies. Technologies that provide opportunities for remote interaction in various spheres of human activity have gained unprecedented scale, including FinTech technologies. COVID-19 has accelerated digital trends, as well as significantly changed the behaviour of customers who began to prefer digital payments, banking applications, etc.. Companies around the world have rethought the value of modern technology, with a huge potential to create a unique personalized offer in a time and place convenient for the client. Obviously, new opportunities have emerged for the FinTech industry. Current market conditions and social distancing practices have impacted each category of FinTech companies differently, with unique challenges that need to be addressed. The unique strengths, knowledge and skills of FinTech companies give them great advantage and flexibility to overcome challenges. The question is how FinTech companies can use their unique knowledge to take advantage of new opportunities in the future. It is interesting to analyze the most recent data available in order to understand in which direction FinTech technologies are moving. FinTech is constantly evolving, adding new technologies and opportunities. The purpose of the work is to identify the most promising technologies in the field of FinTech. To do this, it is important to analyze the views of the scientific community through an analysis of the latest research in this area. The business view of technology has been analyzed by studying the dynamics of patents in this area.

Keywords – FinTech, Innovations in the field of knowledge, Patent analysis, Consumer preferences, Market analysis.

Paper type – Academic Research Paper

1 Introduction

The world is increasingly faced with events that can be considered a "black swan". Thus, the COVID-19 pandemic has significantly changed the behavior of customers and businesses, influenced the development of technologies, including FinTech technologies. Thus, Global FinTech's investments in the first half of 2020 amounted to $25.6 billion with 1,221 transactions (Pulse of Fintech, 2020). At the same time, the main segments of FinTech by transaction value in 2020 were distributed as follows: first place digital payments, then personal finance, alternative lending, alternative financing (79 Key Fintech Statistics, 2020). The unique strengths, knowledge and skills of FinTech companies give them a great advantage and flexibility to overcome difficulties. The question is how FinTech companies can use their unique knowledge to take advantage of new opportunities in the future.

According to the KPMG International report (Pulse of Fintech, 2020) during 2017-2020, interest in FinTech cooled, so, since the end of 2019, the overall global investment activity (venture, private and M&A) in FinTech, global venture activity in the field of financial technologies, global M&A activity in the field of financial technologies has fallen. This may be due to the fact that the main players were waiting, assessing the impact and development of the pandemic, but it may also be due to the blurring of boundaries between financial technologies, large technology providers and platforms. Studies shows that although in 2019 only 1% of the US population had a digital account, a year later, in 2020, almost 25% of the population chose a digital-only account (Avasthi, 2021). In this new digital environment, the FinTech sector was opening up new opportunities in 2021 and beyond. The results of the study (Tut, 2023) show that for emerging markets, FinTech not only partially mitigated the negative impact of the COVID-19 pandemic in the first quarter of 2021, but also accelerated consumer adoption of FinTech and digital adaptation, especially in the third and fourth quarters of 2022.

Digital innovations challenge the traditional way of providing financial services to companies; the so-called FinTech phenomenon refers to startups that use the

latest technology to offer innovative financial services. Consider the total cost of investments in FinTech companies around the world (Fig. 1).

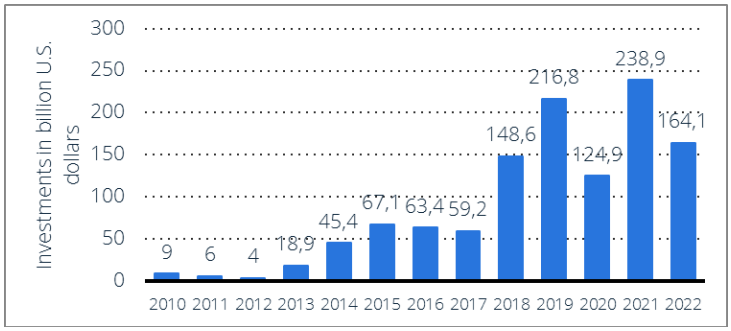

Fig.1. Total value of investments into fintech companies worldwide from 2010 to 2022 (in billion U.S. dollars) - Source: The Pulse of Fintech H2 2022, page 8. PitchBook; KPMG. Statista.com

The total value of investments in FinTech companies worldwide increased dramatically between 2010 and 2019, when it reached US$ 216.8 billion. However, in 2020, investments of FinTech companies decreased by more than a third, falling below 125 billion US dollars. The value of investments increased again in 2021 to almost $239 billion. 2022, however, was another slow year for FinTech.

Due to its heavy reliance on large amounts of data, the financial services industry is ripe for the breakthrough offered by new technologies. Large volumes of historical data on banking, insurance, mortgage and financial trading have been integrated with deep learning algorithms to automate routine tasks, reduce risks, prevent fraud and generate new ideas.

The purpose of the work is to identify the most promising technologies in the field of FinTech. To do this, it was necessary to analyze the views of the scientific community through an analysis of the latest research in this area. The business view of technology has been analyzed by studying the dynamics of patents in this area.

In this regard, the following research questions have been raised:

RQ1: What are the most promising technologies in the field of FinTech?

RQ 2: What are the risks and prospects of this technology?

The goal includes several tasks:

1. Review of literary sources and identification of the most popular technologies in the field of FinTech.

2. Conduct a patent analysis of the technologies identified at the first stage of the study.
3. Based on the results obtained, draw a conclusion about the risks and prospects for the development of technologies in the field of FinTech.

2 Methodology

In the course of the study, a consistent review of the literature was conducted. The sources were searched in the databases: Google Scholar, ResearchGate, IEEE Xplore Digital Library; Wiley Online Library; ACM Digital Library; MDPI; Springer; Scopus. The search period was not limited by years. Patent statistics on blockchain technology were also analyzed from the moment of its first appearance to the present. The search was conducted by patent offices. The country breakdown shows where the patents were registered. Keywords were searched in the title, patent annotation, as well as in the text of the patent application. Patent statistics were provided by Orbis Intellectual Property to Bureau van Dijk. The statistics of the www.statista.com resource were also used.

We understand that the research methods used have the following limitations: patent analysis provides information with a delay, so it does not show the latest trends. This limitation is partially compensated by the fact that the first stage uses the analysis of the latest scientific research, including those that are still "in print". That is, at the first stage of the study, we have the opportunity to determine the current trend, and then, at the second stage, to supplement the identified trend with patent analysis.

3 Theoretical background

Before proceeding directly to the study, it is necessary to understand the definition of the concept of "FinTech". Technology has always been a part of the financial world, since the 1950s, when credit cards and ATMs appeared, and to the present, when artificial intelligence and blockchain technologies are actively used. Technologies have begun to play such a significant role in finance that a specific term has appeared to describe the intersection between them, that is, FinTech. FinTech refers to the application of new technological advances in the products and services of the financial industry. The definition is quite broad and includes "innovative ideas that improve financial service processes by offering technological solutions in accordance with various business situations, while ideas

can also lead to new business models or even a new business" (Di Pietro et al., 2021). Other authors define FinTech as a new type of computer algorithm that is currently difficult to implement (Barocas and Selbst, 2016). The term financial technology, or FinTech, came into use in 2014 (Pedersen, 2015). According to KPMG (Statista, 2023), the term "FinTech" is used to describe innovative start-up companies operating in the financial sector that use modern technological solutions in the financial services sector to offer products with improved digital capabilities and provide broad access to financial products at a lower price than traditional players.

Some authors distinguish the concepts of FinTech, InsurTech and blockchain technologies separately (Chakravaram et al., 2021 a,b). But we can't agree with that because FinTech is an industry and blockchain is a technology. Other authors include blockchain technology and cryptocurrencies in the concept of FinTech (Dranev, 2019). KPMG International identifies Payments, Insurtech, Regtech, Wealthtech, Blockchain/cryptocurrency and Cybersecurity as FinTech segments (Pulse of Fintech, 2020).

The authors Wang et al., 2021 systematized the directions of FinTech, identifying 9 dimensions (Table 1).

FinTech dimension	**Technologies within the direction**
Network channel dimension	Mobile banking, Online Banking Service, Internet Banking, E-bank
Resource allocation dimension	Internet loan, Internet lending, Network investment, Online lending, P2P loan
Internet technology dimension	Internet of things, Vehicle interconnection, Mobile Internet, 5G, Mobile communication
Big Data dimension	Big Data, Data Mining, Big Data Analysis, Big Data Application
Distributed technology dimension	Cloud Computing, Cloud Platform, Digital Currency Bitcoin, Blockchain Technology
Risk management dimension	Internet insurance, Internet financing, Network financing, Online financing, Network insurance
Security technology dimension	Biometrics, Fingerprint Identification, Iris Recognition, Face Recognition, Voice Recognition
AI dimension	Artificial Intelligence, Intelligent Robot, Natural Language Processing, Machine Learning
Payment dimension	Mobile Payment, Third Party Payment, QR Code Payment, Network Payment

Source: Wang et al., 2021.

Within the framework of this study, we accept FinTech as a concept that includes all of the above concepts, including Insurtech, Regtech, Wealthtech.

A large number of studies are devoted to the use of blockchain technologies. Many authors single out this technology as a technology that will play a key role in the development of the financial industry (Bouri et al., 2020, Aylin and Ahmet, 2020, Kabulova and Stankevičienė, 2020, Deng and Wu, 2021, Agarwal et al., 2021, Bhasin and Rajesh, 2021, Avasthi, 2021, Zhao, 2021, Wang et al., 2021, Le et al., 2021 Ali et al., 2023, Khan et al., 2023 van der Linden and Shirazi 2023). At the same time, the scope of application of this technology is extremely wide: secure information exchange, digital currency, asset tracking and management, digital identification, compliance with regulatory requirements, financial flow tracking, digitization of documents and protocols, licensing and credentials, asset tokenization, product supply chain tracking, payments/transaction processing, contract management, internal control, protection against counterfeiting. Options for using blockchain technology in organizations around the world in 2021 are shown in Fig. 2.

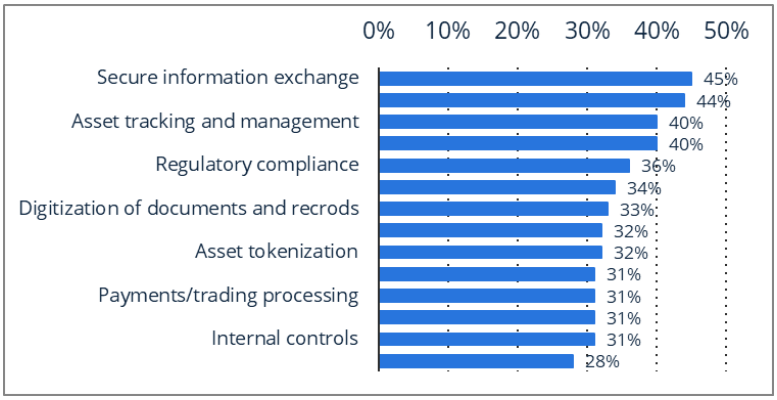

Fig.2. Blockchain technology use cases in organizations worldwide as of 2021
Source(s): Deloitte

Blockchain technology occupies a special place in a number of FinTech technologies. It's been a long time since it's just a word to attract attention. The year 2020 has become a trigger of innovation for many countries of the world, in which there is an active discussion of technology in a practical way on a number of issues related to business, the state and society as a whole. For example, a law on digital financial assets was adopted in the Russian Federation, a roadmap for the development of distributed ledger technology was approved, many

government agencies were involved in working with blockchain: the tax, customs service, Bank of Russia and others. Thus, it can be argued that the recognition of blockchain in the state environment has already come. The state and business already treat technology as a given, but nevertheless, an understanding of specific use cases, potential benefits and possible consequences has not yet been formed.

It is also widely believed that robotic consultants and recommendation systems will play a leading role (Martínez-Plumed et al., 2021, Priyono & Azhar, 2021, Mankins et al., 1995). For example, the Liu 2020 study considers the technology of robotic consultants as a new model of investment and financial management based on Internet platforms, artificial intelligence and quantitative trading technologies. The study examines how to standardize the Robo-consulting platform, effectively control financial risks in the investment process and protect the interests of investors - an urgent problem in the Robo-consulting industry. The papers Bunnell et al. (2021) and Unzueta et al. (2021) analyze the FinTech recommender system. The study by Chen et al. (2021) examines the technology of predict stock prices for the next period. This technology can also be attributed to robotic consultants, as a hybrid model based on machine learning for stock forecasting and an average deviation model for portfolio selection. In particular, this model includes two stages: stock forecasting and portfolio selection. Using the Shanghai Stock Exchange as a sample for the study, the results obtained demonstrate that the proposed method surpasses traditional methods (without stock forecasting) and benchmarks in terms of profitability and risks. The Nieves, 2021 study presents a hybrid method of recommending financial products: joint filtering in combination with content filtering. This task involves learning intelligent algorithms to create the right recommendations for each client. The expected results are a forecast with a high degree of accuracy due to the integration of a hybrid method that provides personalization of products offered by the bank.

A number of studies address the issues of accessibility of financial services using mobile money (Senyo & Osabutey, 2020, Al Nawayseh, 2020, Zhang et al., 2020). The issue of access to financial services is considered one of the main problems that societies face during crises, the above-mentioned studies attach great importance to the availability of financial services, thanks to FinTech technologies, emphasize the social component of FinTech development.

Sustainable development has become an important topic because of the environmental damage caused by economic activity. In this scenario, FinTech can

help improve the use of resources and ensure sustainable economic development. To better understand this relationship, panel data from 66 countries were collected for the period 2010-2021. The Green Growth Index (GG) was developed and its relationship with several FinTech variables was analyzed. The results show that the popularization of the Internet and Findex have a positive impact on "green" economic activity, while carbon emissions have a negative impact. Population growth and unemployment can also affect green growth. Importantly, this study highlights the need for policymakers to promote the adoption of financial technologies to achieve greener economic growth (Awais et al., 2023).

The article Ceaparu (2021) analyzes Fast Data and Big Data technologies as the most promising within FinTech. Bunnell et al. (2021) considers Big Data as the most promising technology.

Summing up the above, it can be reasonably argued that the research and analysis of the blockchain technology market within the framework of FinTech seems relevant and timely.

4 Patent analysis

Table 2 shows the indicators of the introduction of FinTech services worldwide in 2019 by category. China has been a leader in banking and payments, with 92 percent of FinTech adoption by small and medium-sized enterprises in this category.

Table 2. Leading countries for fintech adoption 2019, by category

County	Banking and payments	Financial management	Financing	Insurance
China	92%	91%	89%	62%
U.S.	52%	49%	41%	31%
Mexico	49%	36%	31%	23%
South Africa	47%	43%	34%	26%
U.K.	41%	37%	34%	24%
Total	56%	51%	46%	33%

Source: BI Intelligence

The figure 3 shows the cost of venture financing of financial technologies worldwide in 2021 by sector.

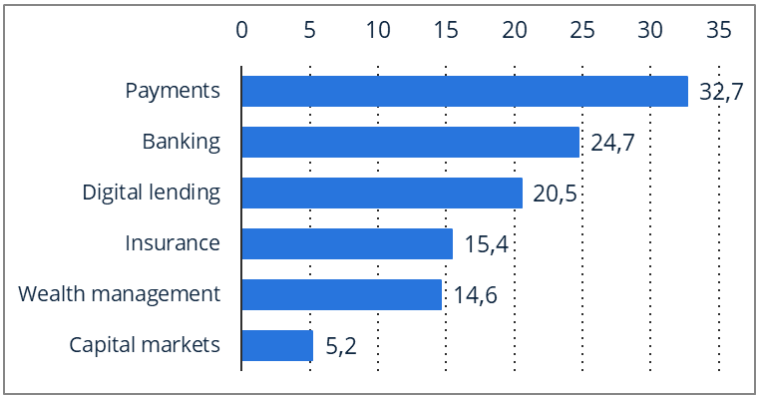

Fig. 3. Value of venture capital-backed funding in fintech worldwide in 2021, by sector (in billion U.S. dollars)
Source: CB Insights

In 2021, FinTech companies specializing in payment services were the most funded FinTech companies in the world. Financing raised through investment deals with venture capital in FinTech companies operating in the payments segment amounted to about $32.7 billion. It was followed by FinTech companies specializing in banking and digital lending.

New technologies such as blockchain, artificial intelligence, big data and other technologies can significantly improve the quality of risk control, optimize financial transactions, improve customer service, optimize the credit process, customer evaluation model, etc.

We will conduct a patent analysis on blockchain technology. Patent analysis has been conducted for the last since the advent of the blockchain (the Bitcoin system, which appeared in October 2008, became the first application of blockchain technology) to the present. However, the bulk of patents began to appear after 2015. At the moment, the absolute leader in the number of patents in the field of blockchain is China (8,027), followed by the USA (6,414), in third place is the World Intellectual Property Organization (WIPO) (3,748).

The number of patent applications for blockchain inventions filed publicly worldwide in 2020, according to the leading company, is shown in Fig. 4.

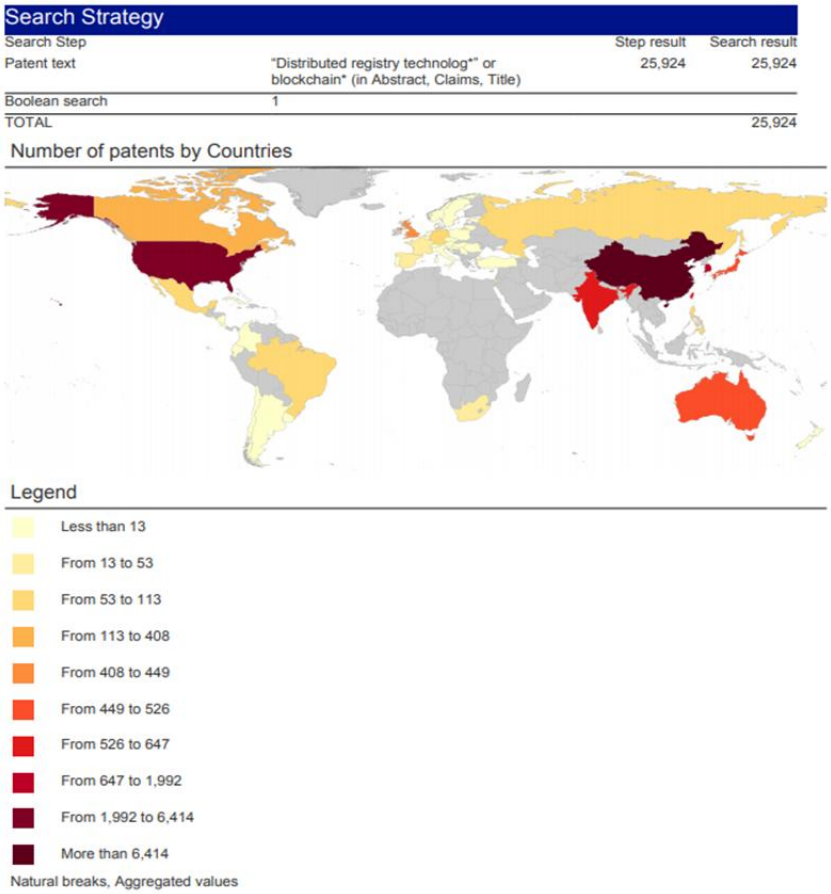

Fig. 4. Search for the keyword "blockchain", world map
Source: Orbis Intellectual Property (Bureau van Dijk)

In 2020, global spending on blockchain solutions reached $4.1 billion. The growth of spending on blockchain solutions has been jeopardized due to the outbreak of coronavirus (COVID-19), but still remains quite high - spending for 2020 is more than 50 percent higher than in the previous year. According to forecasts, spending on blockchain solutions will continue to grow in the coming years and will reach almost $18 billion by 2024 (Statista, 2021). Global spending on blockchain solutions from 2017 to 2024 (in billions of US dollars) is shown in Fig.5.

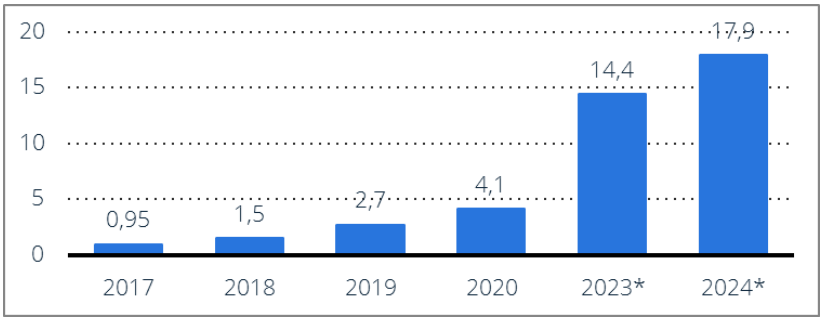

Fig. 5. Spending on global blockchain solutions in 2017-2024 (in billions of US dollars).
Source: www-statista-com

Distribution of global blockchain patents in 2021, by country is shown in Fig.6.

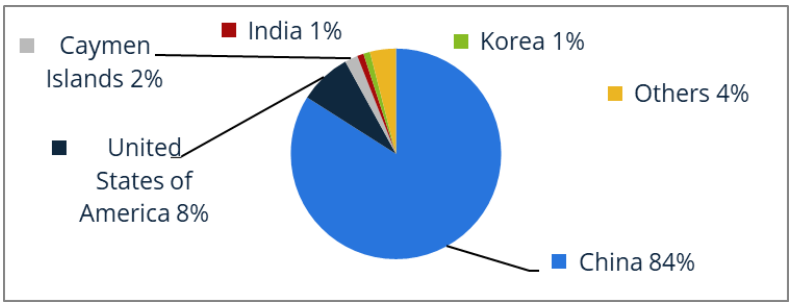

Fig. 6. Distribution of global blockchain patents in 2021, by country
Source: Statista.com

It is obvious that interest in the technology is growing. Consider the distribution of the blockchain market value worldwide in 2020 by sector (Fig.7).

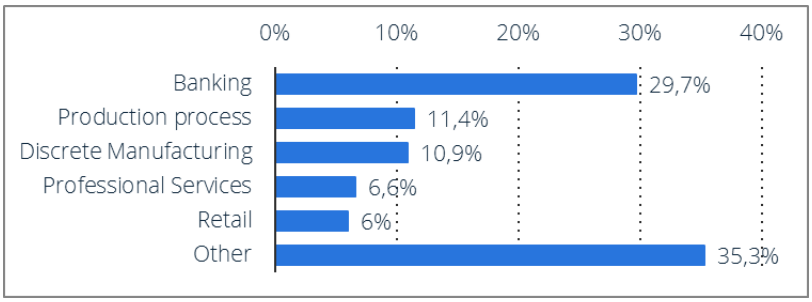

Fig.7. Share of global blockchain market value in 2020 by sector
Source: Statista.com

The largest consumer of blockchain technologies is the banking sector, which occupies 29.7% of the blockchain market in 2020.

5 Discussion and conclusion

Recent challenges have shown that the FinTech sector needs to be flexible and innovative, learn from previous periods and create knowledge-based innovations. We consider contactless payments as a new payment model around the world, embedded financing (from payments to loans, insurance and mortgages, companies now offer embedded services adapted to individual customer needs), the desire to create new partnerships within business ecosystems, the introduction of cryptocurrencies (countries are considering the possibility of introducing digital national currencies). COVID-19 accelerated digital trends, and also significantly changed the behavior of customers who began to prefer digital payments, banking applications, etc., which stimulates further investments in FinTech.

We are witnessing the rapid development of technology, the need to hire additional staff, in this regard, expert networks are becoming more and more popular. So, Blockchain 1.0 has turned into Blockchain 4.0, and Blockchain 5.0 appears. Blockchain 5.0 allows you to perform operations in both private and public spheres and can be used by government agencies, commercial and private organizations. We are talking about the widespread use of this technology in the life of society. Blockchain is a promising technology that has gained huge popularity by revolutionizing peer-to-peer information exchange, combining cryptographic principles with decentralization, immutability and transparency.

RQ1: What are the most promising technologies in the field of FinTech?

As a result of the conducted research, it was revealed that blockchain currently occupies a privileged place in the structure of FinTech.

RQ2: What are the risks and prospects of this technology?

In this regard, the opinion of Han, L. (2020), who studied the relationship between the trust mechanism and the iterations of the currency system from the era of early civilization to the present day, is interesting. The author delved into the history and evolution of the "money format", illustrated the changes associated with the concepts of "TRUST" and "CONVENIENCE" as a timeline. As a result, I concluded that the final path of money is bitcoin and cryptocurrency.

By itself, blockchain technology has the ability to ensure mutual trust in a system where it could not have been initially. However, it also has disadvantages, criticism, for example, as the possibility of a consensus, when it becomes possible to manipulate the blockchain in the interests of a related group of persons. There is also a risk of data substitution and mutual responsibility.

On the other hand, the financial technology environment tends to change rapidly, so it moves away from large and heavy "megalithic" buildings and strives to create a mosaic of microservices. In this regard, it is possible to use blockchain technology in a different way that would meet the demands of time and circumstances, maximize the strengths of the technology and level the "Achilles' heels" of the blockchain.

Recent challenges have shown that the FinTech sector needs to be flexible and innovative, learn from previous periods and create knowledge-based innovations.

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The Roles of Digitalization and Knowledge Sharing in French Company's Performance: The Mediating Role of CSR

Tarek Mejri*

University of Paris-Saclay, France
Univ. Evry, IMT-BS, LITEM
Evry-Courcouronnes, France

Mohamed Anis Ben Abdallah

Université de Carthage, Tunisie
Faculté des Sciences Economiques et de Gestion de Nabeul,
Campus Universitaire Mrezgua- 8000 Nabeul, Tunisie

Tahar-Lazhar Ayed

Hekma Schoolof Business and Law
Dar El-Hekma University, KSA
School of Commerce (ESCS), University of Sfax, Tunisia

Karima Saci

Banking and Finance Department
Dar AlHekma University,
Al Faiha District, Jeddah

* *Corresponding author*

Abstract

The purpose of this study is to examine the impact of digitalization (DG) and knowledge sharing (KS) on the financial performance (FP) of French companies, with a focus on the mediating role of corporate social responsibility (CSR). A survey was conducted among a sample of French companies, and the data was analyzed using structural equation modeling PLS. The results of the study indicate that DG and KS have not a positive impact on the FP of French companies. Furthermore, CSR completely mediates the relationship between DG and FP. These findings suggest that French companies should focus on improving their digital capabilities and promoting KS among employees, while also paying attention to their CSR activities, in order to enhance their FP.

Keywords - Digitalization, Knowledge sharing, CSR, Financial Performance, Dynamic capabilities

1 Introduction

DG and KS are two key factors that can contribute to the success of modern organizations. DG enables companies to streamline their operations, improve customer service, and increase their competitiveness (Kraus et al., 2021; Bouncken et al., 2018). KS, on the other hand, can help companies develop new products and services, improve production processes, and solve problems more efficiently (Lin& Lee, 2006).

However, the benefits of DG can be limited by inequalities in access to information, security and privacy risks, and the inability of firms to fully exploit their knowledge potential (Teece, 2018). In this context, CSR can play an important role in mediating the relationship between DG and FP.

CSR implies that companies take into account the social and environmental impacts of their activities and commit to creating value for all stakeholders (Carroll, 2015). With respect to DG, CSR can encourage collaboration, transparency, and accountability in the use of digital technologies (Kiron et al., 2019). For example, CSR can help companies design more ethical and privacy-friendly information systems, build customer trust and loyalty, and increase their ability to innovate by collaborating with external partners (Nambisan and Baron, 2019). In addition, CSR can encourage KS internally and externally, thereby promoting organizational learning and business competitiveness (Liao et al., 2019).

However, the impact of these factors on the FP of companies is not well understood. Moreover, the role of CSR in mediating this relationship has received limited attention in the literature. Therefore, this study aims to fill this gap by exploring the impact of DG and KS on the FP of French companies, with a focus on the mediating role of CSR. We examine this relationship using data collected from 118 French companies on DG, KS, CSR and FP. We showed that CSR can contribute to strengthening the FP of firms by fostering a culture of innovation and cooperation, and by encouraging the diffusion of knowledge throughout the ecosystem.

2 Dynamic Capability Model

The theory of dynamic capabilities is an important reference for understanding the mechanisms that allow companies to adapt to environmental changes. It highlights the ability of companies to create, extend, and reorganize their resources and competencies to adapt to new market conditions (Teece, 2018). The choice of the dynamic capabilities theory to address the concepts of DG, KS, CSR, and FP is justified by its relevance as a theoretical approach emphasizing the importance of flexibility and adaptability in achieving corporate performance (Trabucchi et al., 2018). Indeed, increasing DG has a significant impact on companies, requiring rapid adaptability to maintain competitiveness. Companies must be able to create, extend, and reorganize their resources and competencies to exploit DG opportunities and defend against threats (Wang and Ahmed, 2007). The dynamic capabilities theory highlights the importance of creating new capabilities and developing existing ones for sustainable performance.

Moreover, KS is considered a key element for enhancing a company's dynamic capabilities. DG offers new opportunities to facilitate internal collaboration and communication, which can strengthen knowledge creation and capacity development (Li, Zhang, and Yang, 2019). However, for DG KS to contribute to a company's performance, it is essential to consider CSR. In fact CSR can play a mediating role in the relationship between DG, KS, and corporate performance by encouraging ethical practices and improving the company's perception by its stakeholders. Thus, the study conducted by Jamali and Mirshak (2007) on CSR in the context of developing countries highlights that CSR can contribute to improving the company's reputation, which can strengthen stakeholder trust and stimulate company performance.

In light of all these elements, dynamic capability theory seems to provide a rich and legitimate framework for understanding the complex relationship between DG and KS, and their impact on FP with a focus on the mediating role CSR.

3 Theoretical Background and Hypothesis

3.1 Digitalization and Financial Performance: An empirical Literature Review

McKinsey (2018) stated that in the past five years, more than 80% of companies had launched new DG initiatives to keep up with competitive pressures. While DG is thought to promote companies to perform better by allowing them to adopt more efficient, transparent processes with improved mechanisms of data collection and management to reduce costs and generate more revenues and profits, its impact on financial stability is not as obvious.

The Financial Stability Board (2017) emphasized the fact that there is a need to consider two main areas of risk engendered by the digital development. These are:

1. Micro-financial risks: the main focus of this area of risk is on the poor governance of digital processes which may negatively impact the provision of services. Also, the cyber risk and how it could increase due to the potential intense digital connections between various entities, particularly if important activities commands from different companies are dependent on the same third party.
2. Macro-financial risks: These risks tend to threaten the stability of different digital systems together. The most critical point is the contagious nature of the caused distress which may escalate and impact the whole economy. Also, due to the fast features of DG an overreaction to the rapid flow of news may create excess volatility that negatively impact economic growth. Major moral hazards may also be created by highly connected entities which could alter the market structure limiting the possibility of other providers interfering to resolve the any related issues.

Guo and Xu (2018) departed from acknowledging the potential as well as the drawbacks of DG to examine its impact on the operational and FP of 2254 Chinese companies in the manufacturing sector over the period 2010 to 2020. Using multiple linear regression analysis with different measures of performance, namely profitability and productivity they concluded that digital technologies do have a positive impact on both operational and FP.

Abou-Foul et al., (2020) examined the relationship between DG, servitization and FP using the Structural Equation Model with a sample of 185 manufacturing companies in the US and Europe. FP was measured via three variables which are revenues generation, market value and profitability. Both DG, servitization were found to have a direct positive relationship with FP.

Cherkasova and Slepushenko (2021) claimed that in Russia, DG is a pressing issue which needs to be investigated in relation to the FP of companies. The authors used multisectoral data of 482 companies over the period 2017–2019 to test whether or not the FP measured by operating profit margin is impacted by the (0–100) DG Index of McKinsey, with 0 being no DG and 100 representing the maximum DG. Their multiple regression analysis results showed that overall, there is a positive influence of DG on FP.

Jardak and Ben Hamad (2022) & Wroblewski (2018) both studied the relationship between digital maturity and FP empirically in Sweden with 23 and 24 companies respectively. Their results indicated that it is not evident for DG to have a positive impact on performance. In fact, Jardak and Ben Hamad (2022) found a weak negative impact of degitalisation on operating performance. This somewhat validated Wroblewski (2018) earlier conclusion that ROA and ROE are negatively influenced by Digital maturity in Sweden.

A recent study from Indonesia conducted by Gusti (2022) also aimed at investigating the role of digital capability and digital orientation on FP with data collected from 200 Micro, Small, and Medium-sized (MSMEs) companies. Their regression analysis results indicated that a significant positive relationship was found between DG and FP.

H1 : Digitalization impacts positively financial performance.

2.2. Knowledge Sharing and Performance

KS is the practice of sharing information, skills and experiences between individuals or groups. This practice can have a significant impact on organizational performance (Jennex, 2008; Nonaka et Takeuchi (1995). Indeed, by sharing their knowledge and skills, individuals can contribute to the achievement of common goals and increase the quality and efficiency of work (Wasko et Faraj, 2005).

KS can also have a significant impact on the FP of companies. Several studies have shown that KS can help companies achieve cost savings, reduce expenses,

and increase revenues. For example, Wang and Noe (2010) found that KS can help companies reduce training costs and improve production quality, which can translate into increased profits. Similarly, Szulanski (1996) demonstrated that KS can help companies avoid costly mistakes and solve problems more quickly, which can also lead to significant savings.

KS can also help companies innovate and develop new products and services, which can contribute to increasing revenue and improving FP. Lin and Lee (2006) found that KS can help companies create innovative products and services by promoting collaboration and creativity among employees. Likewise et al (2002) prove that KS can help companies develop new products and services by fostering innovation.

Moreover, KS can help companies improve their reputation and brand image, which can result in increased customer loyalty and sales. Hansen and Von Oetinger (2001) emphasized the importance of KS in creating a strong and positive brand image for companies. Similarly, Cabrera and Cabrera (2005) showed that KS can help companies improve their reputation by providing high-quality products and services.

Finally, KS can also help companies develop strategic partnerships and alliances, which can contribute to increasing revenues and improving FP. Grant (1996) highlighted the importance of KS in creating effective partnerships and strategic alliances. Likewise, Cummings and Teng (2003) demonstrated that KS can help companies collaborate with other businesses to develop new products and services and to reach new and larger markets.

H2. Knowledge Sharing impacts positively financial performance

2.3 The Relationship between Digitalization and CSR

DG and CSR greatly promote the competitiveness of companies (Orbik and Zozuľaková 2019). The stakeholder theory is the most mobilized theory to examine the association between CSR and DG. It states that companies undertake voluntary practices based on ethical, legal, environmental, economic and social actions for the benefit of different stakeholders (Freeman et al., 2010, Spence et al., 2016, Caroll, 2018).

Nowadays, companies can no longer ignore their social responsibility. DG supports this need (Ramirez-Peña et al., 2020). Indeed, digital technologies play a major role in improving the contribution of companies to sustainable

development and in strengthening relationships with stakeholders. This premise has been advanced by Santoalha et al. (2021) and Cardinali & De Giovanni (2022) who have shown the contribution of the use of digital technology in green practices.

Furthermore, digital transformation is pushing companies to be more attentive and transparent to their stakeholders (Paiola & Gebauer, 2020). The latter are increasingly demanding of companies (Schiavone et al., 2022). Accordingly, we postulate that a company's digital transformation increases the importance and influence of stakeholder demands, thereby increasing CSR participation. We therefore expect a positive relationship between DG and CSR, and we can propose the following hypothesis:

H3. Digitalization impacts positively CSR.

2.4. The Relationship between Knowledge Sharing and CSR

In the current context of global health and financial crises, companies seek to improve their sustainability practices and enhance their reputations as responsible corporate citizens. KS can play a critical role in advancing CSR efforts within organizations, by promoting collaboration and innovation, and creating opportunities for learning and growth. For example, research has shown that KS can lead to more effective CSR strategies and improved environmental performance (Fortanier et al., 2011; Nguyen et al., 2019). Additionally, sharing knowledge and best practices can help companies identify and address social and environmental risks in their supply chains (Van der Wiele et al., 2015).

Moreover, KS can foster a culture of transparency and accountability, which are key components of CSR. By openly sharing information about their sustainability practices and performance, companies can demonstrate their commitment to responsible business practices and build trust with stakeholders (Liu et al., 2021). Furthermore, KS can help companies engage with their stakeholders and incorporate their perspectives into CSR decision-making (Nair et al., 2021).

In addition, it is worth noting that KS can also help companies identify and respond to emerging social and environmental issues. By staying up-to-date with the latest trends and developments in CSR, companies can proactively address potential risks and opportunities. For example, sharing knowledge about the circular economy can help companies reduce waste and improve resource efficiency (Hart, 2017). Additionally, KS can promote ethical behavior and help

companies avoid reputational damage due to social or environmental misconduct (Pohl et al., 2019).

In summary, KS is a critical component of corporate social responsibility. It can facilitate collaboration and innovation, promote sustainability, and foster transparency and accountability. Therefore, companies should prioritize creating a culture of KS and invest in the necessary tools and resources to support it.

H4. Knowledge Sharing impacts positively CSR.

2.5. The Relationship between CSR and Performance

The CSR- performance relationship has been revived the last decade given the interest in CSR (Van de Walle and Brice, 2011). The CSR strategy adopted by the company certainly also has financial and economic implications. A question of major importance for companies and academics alike is whether it is profitable to engage in CSR strategies. One of the main explanatory theories in this work is essentially stakeholder theory. It seeks to describe and limit responsibilities within the firm and considers that good FP is the result of good social performance.

Stakeholder theory views the creation of value at the level of a company as the result of a fruitful collaboration between the different stakeholders. In line with this analysis, (Pera et al, 2016 and Freudenreich et al, 2020) emphasize that value creation is a process that includes the participation of multiple stakeholders.

Efforts to satisfy these stakeholders gain competitive and performance advantages (Freeman, 1984). According to this economist, the ultimate goal of the firm is profit maximization. A favorable social context generates a good reputation for the company and positively impacts its value (Cheung, 2010).

Several works provide mixed results regarding the impact of social engagement on performance (Lins et al., 2017; Spence et al, 2011; Dupuis, 2008; Waddock and Graves, 1997; Yu and Choi, 2014; Chtourou and Torki, 2017).

A classic stream of literature points to a negative relationship between CSR and performance ((Friedman, 1970; Aupperle et al, 1985; Chetty et al, 2015; Nguyen et al, 2015, Jahmane and Hofaidhllaoui, 2021). Sun (2012) states, for example, that CSR does not create value for the company, but it leads to huge burdens (Famiyeh, 2017) and expenses. Surroca et al. (2010) did not find a relationship between CSR and performance.

However, the majority of work argues for a positive impact of CSR on performance (Berland, 2007; Dupuis, 2008; Daudigeos and Valiorgue, 2010; Yu

and Choi, 2014; Cheng et al, 2014; Acquier and Aggeri, 2015, Robert et al, 2016; Choi et al, 2018; Devie et al. 2018; Tonmo et al, 2021). In this perspective, the engagement in CSR strategies is vital to achieve economic goals (Garriga and Mele, 2013), it increases the value even in some particular industries (Cai et al, 2012; Reverte et al, 2012).It helps to improve the image of the company and deny strong relationships with shareholders (Davis, 1973) or employees (DeRoeck et al 2014) and improves their productivity (Zhou, 2016) and consequently increases performance.

We can then propose the following hypothesis:

H5. CSR impacts positively financial performance

2.6. The Impact of CSR on the Relationship between Digitalization and Firm Performance

According to Kim (2022), capitalism has long been driven by making profit. In many instances, this has been associated with business misbehavior, corruption, social exclusion and environmental damage. Hence, CSR might be used as a Buzzword for marketing purposes to divert the stakeholder's attention from those undesirable consequences (Piketty, 2020; Rocha et al., 2021)

Porter (2011) and Freeman (2013) were among the first to claim that CSR should not be perceived as an apology from companies for being driven by profit maximization. Rather, it should be built into the business model of any company for the purpose of value creation for the whole society.

This central argument has opened up new avenues for investigating the relationship between CSR and through both KS and DG.

De Galhaud (2016) stated that DG has unquestionably created a fertile ground for the provision of more sophisticated services in terms of both information availability and execution quality. It has also enabled the modernization of processes and practices though which businesses can sustain their performance and growth.

Orbik and Zozuľaková (2019) suggested that DG is the umbrella under which new ways have to be embraced by companies to address their traditional challenges. This should eventually engender a better protection of the environment and also a reduction in pollution levels. For this to achieved effectively, the society needs to change its culture and improve the awareness of all employees working in businesses (Kane et al. (2015) . However, digital

transformation could equally raise serious issues in relation to future employment, the ethical usage of technology and the development of working knowledge among employees. The study concluded that although the speed at which companies are changing in this digital era is unprecedented, CSR is the approach that ensures companies are responsible in their inside working environment besides their responsibility towards the society as a whole. This suggests that CSR plays a mediating role through which companies improve their business strategies and digital transformation and hence, their overall performance.

The importance of CSR and DG was also investigated by Forcadell et al., (2020) with a particular focus on Banks's performance. They argued that companies are increasingly under both competitive and social burdens in the way in which they embrace DG. From 13 developed countries and over the period of 2003–2016, they utilized panel data analysis with a sample of 112 large commercial banks to test the impact of DG and corporate sustainability on performance. They concluded that both variables when occurring together have a positive significant impact on market performance and efficiency of banks.

Similar results were found in a study by Ramos & Casado-Molina (2021) in which a multi-dimensional daily data of seven Spanish banking corporations related to consumer experiences was collected to investigate their impact on the digital Online Corporate Reputation (OCR). These variables included social responsibility, ethics, labour environment and profitability performance as well as attitudes and emotions expressed in social media. The results confirmed that emotion and attitude significantly influenced OCR. The most influential variable was found to be the ethics experience.

More recently, Alfalah et al., (2022) adopted multiple regression analysis to examine the relationship between performance, IT investment and CSR for the Saudi telecommunication sector. They analyzed the responses of 275 participants and concluded that there is a significant impact of investment in IT and effective corporate governance on performance. However, the linkage between investment in IT and performance is only enabled through the mediation role of CSR. Otherwise, no direct association between DG and IT investment was found.

The meditating role of CSR was also observed in recent studies investigating the relationship between KS and performance.

Vassilikopoulou et al., (2018), Elhussiny et al.,(2019) and Mavis et al., (2021) based their research theoretical framework on the CSR stakeholders theory. More

precisely they highlighted the importance of employees being the most significant internal stakeholders. KS among those internal stakeholders is believed to positively impact the performance of businesses at various levels ((Çolak and Şahin, (2019), Saifuddin et al., (2019), Lai et al., (2020) and Parry et al., (2021)).

H6. CSR mediates the effect of digitalization on firm financial performance

2.7. The Impact of CSR on the Relationship between Knowledge Sharing and Firm Performance

Lee and Song (2019) investigated the importance of KS among 263 employees from 22 firms in South Korean hospitality sector and its impact on the CSR and performance. Using the structural equation modeling (SEM), they confirmed that KS has positive influence on the CSR of these firms which in turns influences positively their performance measured by a set of variables related to financial aspects, costumer and employee satisfaction as well as environmental facts.

Jilani et al., (2020) also acknowledged that KS optimizes the intensity of resources allocation which results in more sustainable performance of businesses. They utilized structural equation modelling with 287 responses of participants from 31 banks in Bangladesh. They tested whether or not knowledge hiding and employees' ambidexterity have a mediating feature in the proposed positive relationship between KS and sustainable performance. Their findings revealed that sustainable performance is significantly determined by KS among employees indirectly via the proposed mediated variables.

Zhang and Wu (2020) focused on ethical leadership in Chinese companies and its role in impacting CSR activities and performance. Based on the responses of 327 employees analysed via the structural equation modeling (SEM), they concluded that performance can be improved by CSR and ethical leadership which promoted KS practices within companies. Hence, KS impacted performance only through their chosen CSR mediator which is ethical leadership.

Aamir et al., (2021) also argued that employees who engage more with KS tend to have better ambidexterity and eventually contribute to the overall performance of companies. With 240 employees of manufacturing firms in Pakistan they tested the link between ambidexterity, KS and sustainable performance. Their SEM-PLS results revealed due to the mediating effect of employee's ambidexterity, KS had a positive significant impact on sustainable performance.

The authors of this paper found no recent studies which looked into the impact of KS on CSR and performance beyond the year 2021.

H7. CSR mediates the effect of Knowledge Sharing on firm financial performance.

3 Research Methodology

All the hypothesis illustrated in this study were tested through the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach. This technique is considered the most suitable for our analysis as the sample we used is considered relatively small (n = 118) and we predict in our model dependent variables (Hair et al., 2017). Multiple items were used to measure each construct. All the items used were extracted from previous studies as summarized in the following table of reliability and validity.

118 retained valid surveys were collected from French companies between October and December 2022 using the non-probabilistic convenience sampling as the participants are easy to recruit and can represent the entire population of study (Matthews and Ross, 2010). Four reflective constructs are used in the analysis and evaluated on a five-point Likert scale (1 = I totally disagree; 5 = I totally agree). Invalid responses were removed to ensure a good measurement. Two independent variables Digitalization (DG) and Knowledge Sharing (KS) predicted the dependent variable (FP). CSR as a mediator was inserted in the model to explain in-depth direct relationships between DG, KS and FP.

The sample used in this study is composed of 47.5% males and 52.5% females. Most of the respondent are under 26 years old (67.8%) and qualified as non-executives' staff. Most of the respondents questioned in this study have under 5 years of experience (86.4%), (table 2). About 50% of the firms questioned are from service sector however only 8.5% of firms are industrial and 28% are commercial. Furthermore, most of the firms in our sample are operating in private sector (about 85%) while only 8.5% are public.

Table 2: Sample Characteristics

Characteristics	Groups	n	%
Respondents			
Gender	Male	56	47.5
	Female	62	52.5
Age	=<26 years	80	67.8
	>26-45 years	38	32.8
Qualification	Non-executive	102	86.4
	Executive	16	13.6
Years of experience	<5 years	102	86.4
	5-9.99 years	12	10.2
	10-19.99 years	2	1.7
	>=20 years	2	1.7
Firms			
Sector			
	Industrial	10	8.5
	Commercial	33	28
	Service	60	50.8
	Others	15	12.7
	Private	100	84.7
	Public	10	8.5
	Others	8	6.8

3.1 Running PLS Algorithm for measurement model

Before assessing the significance of the path coefficients of the different structural links, two main stages were followed. The first one, is the measurement model evaluation which ensures reliability and validity through running PLS algorithm. Reliability and validity of the constructs are considered adequate when values of internal consistency (cronbach's alpha, composite reliability) and discriminant validity (AVE, Fornell-Larker) were satisfactory. Cronbach's α and composite reliability were above the threshold of 0.7 which supports the good reliability of the constructs. All items with loadings under the threshold 0.7 were removed. However, outer loadings between 0.4 and 0.7 were kept as they didn't impact reliability and validity of the constructs' measurements.

Table 3: Reliability and validity

Codes of items	Items in questionnaire	Outer Loadings	Reliability		Validity	R^2	HTMT
			Internal consistency reliability		Convergent validity		
			Cronbach's alpha	Composite reliability	Average Variance Extracted (AVE)		
Corporate Social Responsibility (Nguyen et al., 2021)							
CSR10		0.777	0.922	0.933	0.501	0.186	Yes
CSR11		0.611					
CSR13		0.789					
CSR14		0.780					
CSR15		0.659					
CSR16		0.736					
CSR17		0.660					
CSR18		0.705					
CSR19		0.579					
CSR5		0.706					
CSR6		0.739					
CSR7		0.800					
CSR8		0.749					
CSR9		0.706					
Digitalization (McKinsey & Company, 2016)							
Digit1		0.789	0.834	0.882	0.602	-	Yes
Digit2		0.815					
Digit3		0.739					
Digit4		0.665					
Digit5		0.851					
Knowledge sharing (Rajput and Talan, 2017)							
KS1		0.731	0.809	0.862	0.511		Yes
KS2		0.676					
KS3		0.666					
KS4		0.770					
KS5		0.781					
KS6		0.652					
Financial Performance (Yu et al., 2021)							
Fin_Perf1		0.899	0.906	0.934	0.780	0.132	Yes
Fin_Perf2		0.911					
Fin_Perf3		0.879					
Fin_Perf4		0.842					

All average variance extracted (AVE) measures exceed the threshold 0.5 which confirmed a good convergent validity of the constructs as the table above showed.

To examine the discriminant validity, Fornell and Larcker (1981) criterion and heterotrait-monotrait ratio (HTMT) (Henseler et al., 2015) were used. Hence,

square-root of the AVE values for each construct is above the highest correlation between two different constructs. For example, the square-root of the CSR is 0.718; Correlations between CSR-DG = 0.437, CSR-FP = 0.354 and CSR-KS = 0.282 are all above 0.718 which indicated good discriminant validity. (Hair et al., 2012; Henseler et al., 2016). Moreover, all HTMT values of the constructs are below 0.9 which supports that discriminant validity is satisfied (Henseler et al., 2015).

Table 4: Fornell-Larcker criterion

	CSR	DG	FP	KS
CSR	**0.718**			
DG	0.437	**0.774**		
FP	0.354	0.295	**0.883**	
KS	0.282	0.453	0.217	**0.715**

3.2 Running bootstrapping for structural model

To test the whole model, PLS-SEM approach was used. Results showed that only two direct links are significant. CSR impact significantly **FP** (β CSR -> FP = 0.270, t = 2.489, f^2 = 0.069, p = 0.013< 0.05). Moreover, DG impacts significantly CSR (β DG -> CSR = 0.389, t = 4.379, f^2 = 0.150, p = 0.000 < 0.05). Impact of CSR on FPis considered low as the value of f^2 *is less than 0.15.* However, the impact of DG on CSR is considered moderate as f^2 *is 0.15.* Regarding the other direct links, they are non-significant as their p values are all greater than 0.05.

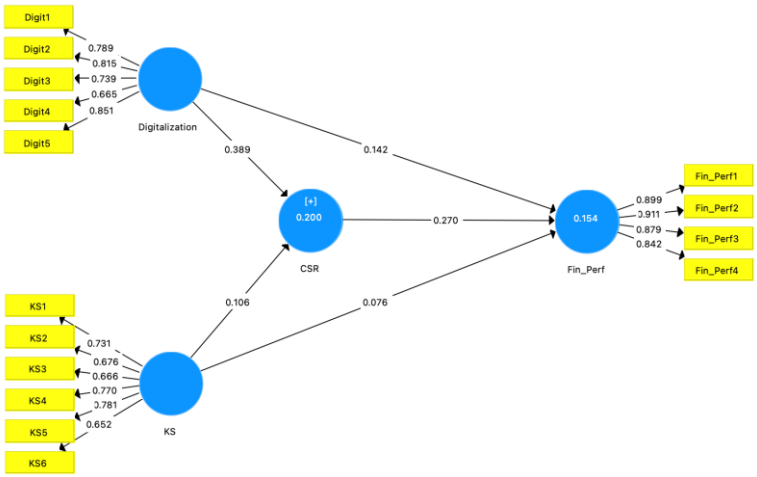

Figure 1: The structural model

Table 5: Results of the structural model path coefficients (significant links)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	f^2
CSR -> FP	0.270	0.279	0.109	2.489	**0.013**	0.069
DG -> CSR	0.389	0.402	0.089	4.379	**0.000**	**0.150**
DG -> FP	0.142	0.135	0.106	1.342	**0.180**	**0.016**
KS -> CSR	0.106	0.137	0.102	1.036	**0.300**	**0.011**
KS -> FP	0.076	0.093	0.135	0.567	**0.571**	**0.005**

In order to explain more the relationship between *DG, KS and FP,* indirect relationship mediated by the CSR was tested. As a first stage we test the direct link between *DG, KS and FP*. Then, the indirect impact between *DG, KS and FP* through CSR was evaluated to check if the mediation exists or not and what type of mediation that CSR can play (Zhao et al., 2010). Statistical results showed that CSR played a full mediation role in the relationship DG – FP as the indirect effect is significant (β CSR -> CSR -> FP = 0.105, t = 2.048, p = 0.041< 0.05) whereas the direct effect is not significant. Moreover, CSR did not play any mediation role between KS and FP as the indirect effect between KS and FP is non-significant.

Table 6: Specific indirect links

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
DG -> CSR -> FP	0.105	0.111	0.051	2.048	**0.041**
KS -> CSR -> FP	0.029	0.040	0.036	0.798	**0.425**

To complete the picture of the path model relationships, this research considers unobserved heterogeneity in the analysis. This can lead to correct all conclusions and ensure the validity of results and generalized valid structural results (Sarstedt and Ringle, 2010). As a first step, finite mixture partial least squares procedure (FIMIX-PLS) was run. Results showed that two-segment solution considered as the best number of heterogeneous groups that takes into

consideration the practicability, the parsimony and the manageability of each class (Sarstedt al., 2009; Sarstedt and Mooi, 2014; Becker et al., 2015). As a second step and after running Prediction-Oriented Segmentation procedure (POS-PLS) with the two-segment solution, results showed that R^2s of FP in segment 2, composed of 26.9% of the respondents, is very high (66.6%). However, R^2s of FP in segment 1 composed of 73.1% of the respondents, became low (19.6%). The Importance-Performance Map Analysis illustrates clearly the differences within groups and helps to provide managerial implications.

Uncovering unobserved heterogeneity across distinct groups showed the need to reconsider the segmentation to understand deeply the modeling of FP. For the full data set, FP is not importantly determined by DG, KS and CSR. Thus, across the unobserved heterogeneity, FP became highly explained in one segment. However, in another segment all predictors did not play an important role in explaining FP. These results underline the need to be open to the revealed differences.

4 Discussion

This article contributes to a better understanding of the factors influencing the DG and KS of French companies and their relationship with FP. The study on the impact of DG and KS on the FP of French companies with a focus on the mediating role of CSR revealed that there is no direct impact of DG and KS on FP. However, this does not mean that DG and KS are not important to companies. It is possible that the companies of our sample have not adopted effective DG and KS. Moreover, it seems that the measurements of the constructs used in this study should be improved and adapted to the context in order to detect the significant impact of DG and KS on FP.

In addition, CSR has demonstrated a full mediation role in the relationship between DG and FP. The results showed that CSR is a crucial element that explains how DG can positively affect the FP of companies. By engaging in CSR, organizations can enhance their reputation, build trust with stakeholders, and create long-term value. This can lead to improved performance in several ways, such as increased brand loyalty, customer satisfaction, and employee engagement. CSR can also help organizations attract and retain talent, which is increasingly important in the digital age.

Thus, other studies have shown that KS can have a significant positive impact on firms' FP. For example, Chen and Hung (2010) found that KS and learning in online communities can significantly influence members' innovative behavior. Similarly, Schneider and Spieth (2013) showed that sustainability-focused business model innovation can improve FP.

The results showed that a focus on CSR strategies can significantly improve FP through the process of DG. This suggests that French companies can benefit from integrating CSR into their quality-based strategic orientation in order to fully realize the benefits of DG. Overall, this result highlights the importance of considering CSR in DG efforts in order to achieve optimal performance outcomes.

CSR can be viewed as a management practice that aims to ensure that companies consider the social and environmental impacts of their business activities. Companies that adopt CSR practices can improve their brand image and reputation, which can lead to increased customer and investor loyalty, as well as increased profitability.

Overall, CSR can act as a mediator between DG and performance by ensuring that organizations take a responsible and sustainable approach to digital transformation, which can lead to improved performance and long-term success.

5 Conclusion and Recommendations

The main purpose of this research paper was designed to study the impact of DG and KS on FP through the mediating role of CSR.

The results of this study showed that DG and KS have no direct impact on FP. However, CSR played a full mediating role between DG and FP. But, some other studies confirmed that DG and CSR are important factors in improving FP (Bocken et al., 2016; Hussain et al., 2017).

On a managerial level, the study could be relevant for companies seeking to improve their performance by using DG and KS strategies, and integrating CSR practices into their daily operations (Gao et al., 2018; Singh et al., 2019). Thus, the results of this study can help managers to implement more effective decisions making processes in order to improve their company's performance.

On a theoretical level, our research contributes to the literature by highlighting the importance of CSR as a mediating factor between DG, KS, and corporate FP. By combining these three areas, the study offers an innovative and enriching

perspective to better understand the complex links between these different variables through the theory of dynamic capabilities.

Finally, at the methodological level, this study has applied a rigorous methodology by collecting and analyzing data of representative sample. The statistical analysis approach used, verified the validity and reliability of the data which implies therefore rigorous and sound analysis.

In parallel, it is important to note that the results cannot be generalized. Further research works are needed to fully understand the role of DG and KS in the FP in French context. In addition, it is important to consider other factors such as organizational culture, leadership, and employee skills when analyzing the impact of DG and KS on FP.

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The Effects of Policy Mix during COVID-19 Pandemic in Romania

Maria-Alexandra Dalu*

Doctoral School of Economics and International Business
Bucharest University of Economic Studies
Piața Romană 6, Bucharest 010374

Alexandra Horobeț

Bucharest University of Economic Studies
Piața Romană 6, Bucharest 010374

* *Corresponding author*

Abstract

The objective of this study is to determine the impact of the COVID-19 pandemic in Romania and whether the government's interventions and imposed policy measures helped to maintain economic equilibrium.

The crisis generated by the coronavirus pandemic has compelled the authorities to take measures to aid first the health system and then the national economy. During the lockdown, production ceased and economic activities were suspended, resulting in a fall in the volume of trade.

In this context, the paper's goal is to determine whether the applied measures were beneficial for the economic system and whether Romania is on the path towards recovery, but it will also analyse if it is necessary to establish a policy framework to prevent potential future exogenous shocks and what regulations could be adopted for a sustainable recovery that would help the economy, providing support for the future complementary approaches to monetary and fiscal policies.

The empirical analysis has been carried out for the period 2020:1 to 2022:9 on monthly frequency data for Romania. The model employed is a BVAR (Bayesian Vector Autoregression) that provides a simple yet effective way of modelling interactions between macroeconomic variables. In order to analyse the consequences of the mix of implemented policies, we examined and considered as exogenous shocks the NBR's monetary policy rate, the evolution of energy product prices, and the number of new COVID-19 cases.

The crisis caused by the COVID-19 is perceived as a health crisis that necessitates adjustments to public, fiscal, and monetary policies. Although the costs may be high at the moment, the changes will be effective in the future and may result in economic consolidation and a higher level of economic resilience for the Romanian market.

Keywords – COVID-19, resilience, public policy, monetary policy

Paper type – Academic Research Paper

1 Introduction

As the epidemic represented an exceptional exogenous shock, the public, fiscal, and monetary policies implemented by the various European governments at that time were designed to stabilize the economy and prevent a collapse of the financial and commercial markets. However, once the medical impasse is overcome, and because the economies cannot be artificially aided, the mix of policies used during the pandemic, but especially the lockdown, must be reshaped and downgraded, because an economic environment with low, almost negative interest rates, low inflation, and high sovereign debt is not sustainable over the long term, with most crisis policies being used only in the short term to counteract the effects of an exogenous shock.

Due to the high level of uncertainty caused by the coronavirus, as well as its rapid spread, governments were forced to adopt the lockdown policy, which, as beneficial as it was from a medical perspective because it helped to prevent the disease's spread, was as harming to the economy by stopping the evolution of aggregate demand and slowing down production, implicitly decreasing aggregate supply, with the initial effect being an increase in unemployment and a disproportionate impact on small companies.

Even though the implemented policies during the pandemic provided immediate assistance to households, businesses, and economies in general, the effects of these actions on economic activity, unemployment, businesses, and economic confidence remains a central topic of research, as their long-term economic consequences are of capital importance for the near future. In the situation of Romania, where fiscal space is constrained, there is a possibility that the adopted policies would harm the economy in the long run if they are not closely monitored.

The rise of the covid pandemic had a favourable impact on the economy because it accelerated the implementation of existing technological procedures and promoted the development of new ones. The economy is constantly changing, and the pandemic has contributed to a road towards a "new reality". But the economic recovery is insufficient to repair the pandemic's devastation.

An initial effect of the imposed limits is the rise in public debt, but this has experienced a strong growth trend in the majority of countries due to their efforts to support the economy as a whole. However, even if a rapid return to the pre-pandemic scenario is envisaged, governments must be prudent and not greedy regarding the payment of public debt. An expansionist fiscal policy focused on investments is preferable, because at the moment the economy needs impulses to put itself on the normal trajectory and subsequently grow sustainably, moving towards a new era.

2 Literature Review

Even if some of the government's measures are costly, they must be phased out because a sudden withdrawal of the aid during the pandemic could undermine the entire economic recovery, which is undesirable in an uncertain economic environment.

Fiscal incentives will not have immediate benefits if they are implemented late and the economic crisis is more intense. The efficiency of fiscal policy is dependent not only on the influence of the recession on consumer behaviour, but also on the level of public debt in relation to savings (Marinas, 2010). Public debt has a negative effect on economic growth and is greater in emerging economies due to their limited financing capability and underdeveloped markets.

Although the 2007 financial crisis and the coronavirus pandemic are distinct, they are frequently compared from the standpoint of the mix of monetary and fiscal measures that must be adopted during such crises (Jones, 2022). The author stated that the strongest economies in 2007 waited to take action at the earliest symptoms of the crisis, delaying economic recovery to the point that several nations were still recovering from the financial crisis at the start of the COVID-19 pandemic.

Perspectives are still mixed in the literature concerning whether or not monetary and fiscal policies complement one another, with most economists arguing that monetary policy is more effective than fiscal policy, and the most effective framework is represented by monetary domination and fiscal austerity.

However, the onset of the crisis generated by coronavirus altered the perspectives of numerous economists. When the European leaders decided to implement the lockdown to stop the spread of the virus, they were aware that it would shut down important sectors of economic activity, depress prices and

burden government borrowing, but they were also convinced that monetary policy alone is insufficient to stabilize the economy, and that a new fiscal policy approach is required.

The beginning of the COVID-19 pandemic was one of those rare moments in which consensus among policymakers was relatively easy to achieve (Ciufuentes-Faura, 2021). Economists may have had different viewpoints regarding the effects of a long-term disruption to the supply chain or regarding the necessity to implement certain measures, but they could not dispute the fact that the impact of such lockdowns regardless of whether they occurred domestically or in trade key partner countries would have significant implications for output, employment, and prices.

The pandemic is unprecedented in the current economic context. No economist has ever been subjected to the type of global restrictions applied by authorities to stop the spread of the virus, thus none of them can predict how the global economy will act once social isolation restraints are lifted (Chen et al., 2020). This new circumstance also showed that monetary policy can only succeed by adapting to the new challenges the global economy will face.

The evolution of tax revenue in the member states of the European Union was one of the central topics during the assessment of the policies during pandemic (Spulbar et al., 2022). Romania is one of the countries with the lowest rate of public revenue collection and formation. Even if this suggests an increase in the country's vulnerability, it is indisputable that the coronavirus outbreak had hit all European nations, which have witnessed an economic downturn since the beginning of 2020.

Before the outbreak of the coronavirus pandemic, Romania was in a sensitive fiscal position (Constantin, 2021). The crisis caused by the coronavirus epidemic exacerbated Romania's fiscal deficit and compelled the government to take measures that could have led to an escalation of the deficit. Despite the existing limited manoeuvring space, the government adopted certain measures, such as: the program for supporting small and medium-sized businesses - SME Invest Romania; technical unemployment benefit for the period of suspension of the employment contract; allowance for authorized natural persons or other professionals who do not have the condition of employers and interrupt their activity; and allowance for parents staying at home with children during the lockdown.

Despite the fact that, during the pandemic, economic forecasts were not very optimistic from the perspective of a sustainable return and a part of the literature claims that the behaviour of agents has changed permanently, recent studies have demonstrated that the majority of economies have outperformed expectations, and the different behaviour of agents can be viewed as positive and more balanced from the perspective of the transition to a less polluted environment.

Moreover, the COVID-19 effects on electricity consumption, economic growth, and economic agents' behaviour were examined due to their importance (Soava G. et al., 2021). The pandemic's long-term impacts on economic growth and energy consumption, one of the main pillars of sustainable economic development, may require government actions to combat the pandemic and economic collapse. The results showed that economic structure and openness affect resource availability. Government policies also affect non-household energy consumption, which boosts economic growth. Emerging countries, particularly Romania, were less energy-affected by the COVID-19 pandemic.

In Romania, the service sector collapse caused energy consumption to drop, but in more industrialized countries like Germany, Italy, and France, the impact was far less. Despite governments' efforts to manage the crisis, which range from social distancing, restricting transportation, and shutting down the economy, countries still experiencing pandemic outbreaks must develop effective policies to manage it.

Another interesting fact is that the pandemic health crisis harmed Romanian workers' mental health, not only the unemployment rate (Radulescu et al., 2020). In some articles, productivity growth through technological acceleration, mechanization, and automation of company processes, which were exacerbated by the pandemic, is noted and implied to have a positive impact on the labour market.

In the paper conducted at the International Monetary Fund, the authors assumed that the effect of fiscal policy announcements on economic activity across countries is relevant in determining the significance of the mix of policies implemented during the coronavirus pandemic (Deb P. et al., 2021). The results indicated that fiscal policy announcements have an effect on economic activity, particularly in the improvement of industrial production, boosts confidence of investors, and reduce the unemployment.

In another study, the authors claimed that the economic crisis caused by the coronavirus compelled nations to first adopt measures to improve public health issues, and then employ fiscal and monetary policies that they had not used previously (Efraim and Tzur-Ilan, 2020). After only one month of lockdown, macroeconomic forecasts indicated a 3% contraction of the global economy, and if the governmental measures to aid economic agents had not been implemented, it was likely that the shocks suffered by various economic sectors would have affected even more economies on a global scale. The results of the authors stated that the level of fiscal expenditures takes into account the size and development of nations, a fact that is also reflected in the high cost of anti-COVID-19 measures, which can reach up to 7 percent of GDP in developed countries and as little as 3 percent of GDP in emerging economies.

Unfortunately, the fiscal spending, including business assistance, helped "zombie" enterprises thrive and all of this because of a poorly targeted support policy. In addition, in the absence of fiscal aid measures for companies, their contraction and failure would have been even worse (Gourinchas et al., 2021). However, the return to the post-lockdown phase must be handled with caution and in a responsible way so as not to hasten the transition. In the context of increased leverage for both the public and private sectors, it would be necessary to pursue macroprudential, and monetary and fiscal policies that will be crucial for stabilizing the global economy.

As this extraordinary event was viewed as a combination of negative supply shock and supply disruption that exerted pressure on all economic sectors, the investigation's relevance lies in the change in the behaviour of economic agents during the pandemic (Cavallo A., 2020). The author asserts that inflation during the lockdown did not accurately reflect reality, with low-income households suffering the most while the wealthy experienced a slight deflation, resulting in a sharp spike in inflation inequality.

An interesting method is outlined in another research on public policy implemented by Sweden during the first year of the pandemic crisis (Krueger et al., 2020). The "Swedish solution" paradigm is characterized as allowing the virus to run its course without government intervention and allowing households to adjust their consumption behaviour on their own terms.

Additionally, a significant decrease in aggregate spending and an increase in aggregate savings were not unique in the United States (Bachas et. al, 2020). The decline in spending was attributable to job losses and social distancing

regulations, as well as the fact that households were required to remain at home with the exception of grocery shopping trips. Almost certainly, the direct consequences of the COVID-19 pandemic were the key element influencing overall declines in spending. In conclusion, the experts advised policymakers not to hasten the economic recovery, since nearly all consumption has returned mainly to fiscal incentives and support, and the abrupt elimination could generate a shock at the level of the whole economy.

A general problem not only during the lockdown in each country, but also during the period when there were restrictions was generated by the production chains and the inclination of some nations to try to produce domestically what they needed to use in order to replace some inputs which were difficult to reach in the certain countries. In the research of the authors (Bonadio et al., 2021), it was emphasized that the global economy is interconnected via multiple channels, not just distribution channels, and that transit restrictions imposed by each state have impacted economic sectors globally.

3 Empirical analysis, data estimation and results

3.1 Empirical model

The econometric analysis of the paper includes one empirical model represented by a Bayesian Autoregressive Vector (BVAR) model implemented to provide an individual analysis of the examined country and to illustrate how macroeconomic variables respond to an exogenous pandemic shock and whether the policy shock from the adopted government policies affected economic growth.

The Bayesian Autoregressive Vector was selected due to the benefits of imposing a priori beliefs and the absence of a requirement for stationary data in order to prevent the loss of crucial data and information from the time series (Litterman, 1986).

The study focuses on Romania, an emerging country and the analysis has been carried out for the period 2020:1 to 2022:9.

The variables under observation were chosen in respect with the theoretical economic criterion and following certain articles (Pinshi, 2020; Apergis and Apergis, 2021). The variables taken into consideration are represented by inflation rate, ROBOR rate at 3 months, industrial production, unemployment rate,

monetary policy rate implemented by NBR, labour productivity, nominal exchange rate, quotations of energy products, and the number of new COVID-19 cases.

The Bayesian technique allows the VAR models to use non-stationary data in order not to lose the information that can be neglected due to transformation into stationary data series. All variables enter the model in levels. The entire estimation procedure was carried out by employing the BEAR Toolbox (Dieppe et al., 2016) in MATLAB 2020.

Starting from the VAR model (Lutkepohl, 2005), we decided to treat as exogenous variables the quotations of energy products, the number of new COVID-19 cases and the monetary policy implemented by the National Bank of Romania in order to explain the significant contribution of the unexpectedly problems of changes that arise due to the coronavirus pandemic within the implemented model.

The Bayesian VAR methodology combines data and a priori model parameter information to create a distribution that accounts for both kinds of information (Koop, 2003). Bayesian econometrics treats each parameter as a random variable with a distribution probability.

Because the choice of a priori distribution is an important issue in the estimation of the model, in this research the Minnesota distribution was chosen.

Furthermore, the choice of the best Bayesian VAR model was made after computing the Bayes Factor and according to the model's stability characteristic. In the model it was included only one lag as specified by the Bayes Factor. Also, the posterior distribution is derived by Gibbs sampling with a total number of 5,000 iterations and a burn-in sample of 1,000 iterations.

The identification of shocks is carried out via Cholesky decomposition.

There were implemented the impulse-response function, the historical decomposition and the forecast error variance decomposition for the purpose of examining the pandemic effects over the emerging economy of Romania.

In the next section, we present the most important results of the empirical analysis and compare them to prior studies. In certain situations, the observed results were inconclusive or even statistically insignificant; hence, only the most significant results will be presented.

3.1.1 Impulse-Response Functions

The impulse-response functions are used to characterize the response of one variable to innovations in another variable within a system, while the rest of the shocks are zero. Impulse-response functions were developed to provide a better explanation of the evolution of macroeconomic variables in response to an external shock.

The inflation rate responds to a shock in itself by decreasing, reaching a statistically significant bottom after 15 periods. Inflation reduces industrial production and productivity, but both dynamics are unfavourable and reach their minimum during the first ten months of the analysed period.

Contrary to expectations, an innovation shock to the unemployment rate does not affect inflation or the NEER.

Industrial production has shown a limited reaction to labour productivity shocks, declining since the first months examined. The other variables are not statistically significant and sometimes do not change.

The macroeconomy factors do not correlate as promptly with changes in the ROBOR 3M rate although its huge impact on the financial market. In the current model, an innovation shock in the ROBOR 3M rate does not affect unemployment, inflation, industrial production, productivity, or NEER.

Such as the ROBOR 3M rate, an innovation shock in the nominal effective exchange rate does not modify the other model variables. This can also be explained by the fact that NEER is an indicator that only capture relative value.

3.1.2 Forecast Error Variance Decomposition

The forecast error variance decomposition aims to highlight the contribution of each shock to the volatility of a certain variable, and the percentage size of the shock will determine the magnitude of the changes in each variable. The shocks that were taken into consideration are represented by the evolution of energy prices, increasing monetary policy rate and the evolution of new COVID-19 cases, all of this occurred within the period under examination.

Table 1. Forecast Error Variance Decomposition

FEVD	The evolution of energy prices	Monetary policy	Evolution of new COVID-19
Inflation rate	38%	35%	10.8%
Industrial production	20.3%	27.3%	7.7%
Unemployment	34.8%	31.2%	7.9%
Productivity	21.3%	26.6%	7.6%
ROBOR 3M	38.8%	30.1%	10.2%
NEER	25.8%	30.2%	11.6%

Source: own calculations

Inflation is a variable that is highly impacted by all analysed shocks. The highest percentage of contribution to inflation's volatility is represented by the shock given by the evolution of energy prices that accounts for 38% of the its variance, followed by the monetary policy shock that accounts for 35%, and the evolution of new covid cases contributes with only 10.8%.

At the opposite pole, the variables whose volatility is less affected by the studied shocks are industrial production and labour productivity. Even if this is noticeable, in the case of industrial production, the dynamics of energy price growth accounts for 20.3% of this variable's volatility, while the shock generated by new COVID-19 illnesses contributes only 7.7% to its volatility.

To a significant extent, the unemployment rate is also influenced by the monetary policy shock, even though a current pattern toward the formation of the inflation-wage spiral may be noticed as a result of rising prices and the decline in the purchasing power of individuals. In the case of the unemployment rate, the monetary policy shock accounts for 31.2% of its fluctuations, while the shock that was given by additional covid cases only explains 7.9% of its variation.

It appears that the adverse evolution caused by the increase in energy prices contributed with 38.8% to the variation in the ROBOR 3M rate and with 25.0% to the volatility of the NEER. Nominal effective exchange rate is an indicator for the country's competitiveness that characterizes the interaction with its trade partners, and in our empirical model, its volatility appears to be influenced by the internal monetary policy.

As a brief overview, we can state that, despite the fact that this is a controversial topic and the majority of analysts have linked a prospective economic contraction to this shock, the evolution of the appearance of new COVID-19 cases contributes with the lowest percentages to the volatility of the

analysed variables, whereas the shock given by the evolution of energy products' prices contributes with the highest percentages to the variation of the variables.

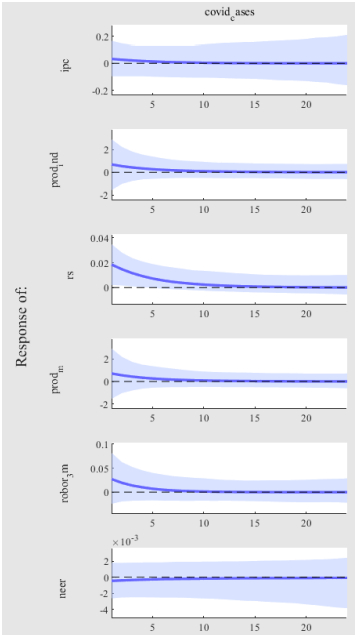
3.1.3 Exogenous Impulse-Response Function

As a quick outline, the exogenous shocks in this empirical model are represented by the appearance of new cases of COVID-19 disease, the monetary policy conducted by the National Bank of Romania, and the rise in energy products' prices, in order to be able to analyse a complex framework. The variables' responses can be seen in the following graphs.

Although the monetary policy implemented by the National Bank of Romania is established within the country and it cannot be said that it could indirectly influence the macroeconomic variables that are considered in this analysis, we assumed the monetary policy shock to be exogenous because the COVID-19 pandemic occurred unexpectedly at a time when the monetary policy rate had remained constant at 2.5% since 2018 and had not been changed for nearly two years. The COVID-19 pandemic compelled central banks to implement a prudential strategy to help the whole economy during the quarantine period.

Through the exogenous shock represented by the appearance of new cases of COVID-19, we wanted to capture the government's public policy regarding the isolation of the citizens, the lockdown since the beginning of the pandemic, and the imposed social distancing. The health crisis could not have been predicted, and the financial factors rapidly responded to its intensification, making it difficult to control the spread of the virus until the vaccine became available.

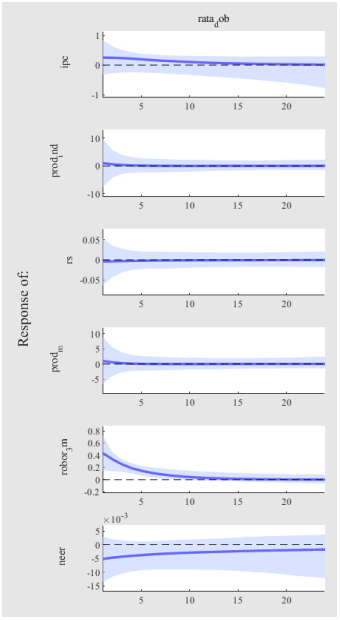
The war caused by Russia in Ukraine at the beginning of 2022 overlapped with a fragility of the economy that was preparing for the transition to green energy, and the sanctions imposed on Russia by the European Union and the purchase of oil from sources other than Russia led to a rapid increase in the prices of energy products, oil and natural gas. In the current model, the shock generated by the increase in energy prices is considered exogenous for the same reason of the impossibility of preventing the ongoing war.



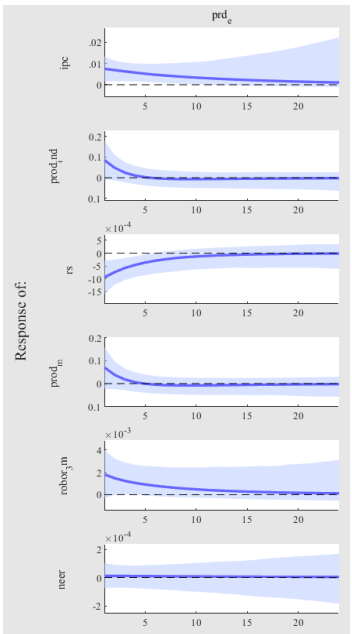
Graph 1. Impulse-Response function to the appearance of new cases of COVID-19
Source: own implementation in MATLAB

The only variables in the empirical model that respond to a shock represented by the emergence of new coronavirus disease cases are the unemployment rate and the ROBOR 3M rate. The unemployment rate exhibits a positive trend, with a constant decline to 0.73% and a statistically significant minimum after 5 months. The same positive dynamic is also observed in the evolution of the ROBOR 3M rate.

With a monetary policy shock defined by a sudden change in its observed path, the ROBOR 3M rate maintains its positive dynamic, but declines by up to 5.47 percent after nine months. Contrary to expectations, the inflation rate does not respond to an adjustment in monetary policy. In contrast to the response of the ROBOR 3M interbank rate, the nominal effective exchange rate exhibits a negative trend but with a continuous increase over the analysed 24 months, with no statistically significant response.



Graph 2. Impulse-Response function to the monetary policy
Source: own implementation in MATLAB



Graph 3. Impulse-Response function to the rise in energy products' prices
Source: own implementation in MATLAB

As expected, the energy shock strongly influences the variables of the model. The responses of industrial production and labour productivity show a downward trend since the first studied months. With a shock generated by an increase in the prices of energy products, the dynamics of the unemployment rate reaches a minimum level from the first period, the negative dynamics persisting later throughout the analysed period.

3.1.4 Historical Decomposition

The historical decomposition of inflation rate reveals a downward trend until the end of the first quarter of 2022, which is supported to a very considerable extent by the unemployment rate. Labor productivity also contributes to this decrease, which recorded low levels at the beginning of the epidemic. NEER indicates a countercyclical role in moderating the decline in inflation, although the impact is minimal compared to the widespread impact of the pandemic at that time. At the end of the examined period, the trend of inflation shifts and enters an upward trajectory, which is influenced by the ROBOR 3M interbank rate, but also because of new cases of covid. Even if the vaccine helped in preventing the spread of the virus and the formation of new mild forms of the disease, it appears that both the war in Ukraine and the coronavirus pandemic have negatively contributed to an accelerated growth in the inflation rate.

Moving on, labor productivity cyclically contributed to the reduction in industrial production, which at the beginning of the outbreak was put under the sign of questioning due to the implementation of technical unemployment and the lockdown until May. Later, the decline in energy and fuel prices, followed by a time in which the economies stagnated, might contribute to a rise in industrial production, but only temporarily, as the rapid reopening of industries and businesses caused blockages in the production chain.

Moreover, NEER contributed unexpectedly and cyclically to the decline in labor productivity. Even if the reopening of borders resulted in a rapid return of economic development, it appears that productivity has not returned to pre-pandemic levels. In certain businesses, such as IT, productivity is deemed to be higher, whereas in industries requiring unskilled labor, productivity has fallen below its pre-pandemic level.

As anticipated and supported by economic literature, the adopted monetary policy rate supported the dynamics of the ROBOR 3M rate. Additionally, the

unemployment rate contributed cyclically to the decreasing trend during the first two years of the pandemic.

The historical decomposition of the unemployment rate indicates a decreasing trend through the second quarter of 2020, which is strongly supported by the ROBOR 3M rate. Industrial production implies a countercyclical role in the rise of the unemployment rate, but since the second quarter of 2021, monetary policy and productivity support a downward path. The fall in the unemployment rate is largely attributable to the ROBOR 3M interbank rate and the NBR's monetary policy. At the end of the analyzed period, the unemployment rate trend appears to remain steady.

Even if NEER is a relative value measure and hence cannot definitively indicate whether a currency is strong in real terms, it appears that the number of new covid cases has contributed to its upward slope over the studied period. Additionally, in 2022, industrial production contributed cyclically to the value increase. From the perspective of the evolution of energy prices, a countercyclical tendency cannot be noticed until the second quarter of 2021.

4 Conclusions

The coronavirus pandemic is regarded as an exceptional exogenous shock that, at the time of its emergence, triggered panic among the population. The nations had never before experienced such events, and the uncertainty caused by the rapid spread of the virus compelled authorities to take unprecedented action.

There were still good parts of the pandemic, such as the acceleration of digital transformation, the change of consumption habits and production patterns, which in the long term will be beneficial for the economy as a whole.

Although the lockdown period was viewed as beneficial at the time, particularly from the perspective of the health system, the social distancing restrictions led to a halt in demand and a decrease in production.

The empirical model reflected the fact that the inflation rate does not respond to changes in monetary policy, while the ROBOR 3M does. As a result of a disruption caused by the emergence of new cases of COVID-19, the unemployment rate and labor productivity fall in the first months analyzed. Also, industrial production and labor productivity decline significantly in response to an increase in energy product prices. In addition, the inflation rate is substantially affected by all shocks, with a large proportion of inflation volatility explained by

the evolution of energy prices, while industrial production and labor productivity are less impacted.

Our findings illustrate the limited effectiveness of the policies implemented during the pandemic and demonstrate how challenging it is to manage exogenous disturbances. Given the short period analyzed, it is reasonable to infer that the adopted policies were less effective in the short term, but that their effectiveness improved over the medium and long term.

As a conclusion, we can say that from a health point of view, social distancing and the imposed lockdown were effective, but they led to decreases in labor productivity, stoppage of production and limitation of demand. In addition, we believe that it is necessary to implement public policies in order to accomplish economic resilience, make investments in health, and develop the economy so that future health crises can be more easily managed.

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Country's Environmental Performance: Does National Culture and Religiosity Matter?

Francesca Di Pillo

Department of Computer, Control and Management Engineering
Sapienza University of Rome
Via Ariosto 25, 00185 - Rome

Fabrizio Rossi*

Department of Economics, Business, Mathematics and Statistics
University of Trieste
Via A. Valerio, 4/1, 34127 - Trieste

* *Corresponding author*

Abstract

The study of a country's environmental sustainability is an important topic because it allows an understanding of the causes and possible solutions for protecting the environment, human health, and natural resources. Among the drivers of sustainable development, there is also the national culture of the countries, which can play a significant role in the implementation of policies aimed at environmental sustainability and which has been the subject of several scientific studies. This paper is aimed at studying how national culture impacts a country's sustainability performance, starting from Hofstede's cultural dimensions (power distance, individualism, masculinity, uncertainty avoidance, long-term orientation, indulgence).

Unlike previous scientific literature, this work considers religiosity as one of the cultural variables that can impact a country's environmental performance. In particular, the two most widespread religions worldwide, Christianity and Islam, were taken into consideration. To evaluate the environmental performance of countries, we utilized the Environmental Performance Index (EPI), since it provides a data-based overview of the status of sustainability worldwide, using performance indicators related to climate change, environmental health, and ecosystem vitality. Additionally, our analysis incorporated socio-economic variables as normalizing factors, including gross domestic product per capita, employment rate, and educational level.

Our research investigates 96 countries across the globe, with 1,056 country-year observations taken into consideration for the period between 2011 and 2021. The study employs a dynamic panel data model that involves a two-step system-GMM. Our results suggest a strong relationship between cultural dimension and EPI.

Keywords – Cultural dimensions, Religion, Environmental performance, Cross-country study, Hofstede framework

Paper type – Academic Research Paper

1 Introduction

The recent Sixth Assessment Report of the IPCC (Intergovernmental Panel on Climate Change) highlights the persistence of environmental issues such as the unsustainable use of energy and land, the continuous increase in greenhouse gas emissions, and how climate change is responsible for atmospheric phenomena extremes, such as floods, droughts, and hurricanes (IPCC, 2023). There are several differences worldwide in the fight against climate change. Some countries have adopted ambitious policies and measures to reduce greenhouse gas emissions and promote the transition to a low-carbon economy, while others have made more limited progress.

Previous studies have shown that a country's environmental performance can be influenced by various factors, such as economic development, allowing more significant financial and technological resources to adopt mitigation measures for climate change (Antoci, 2009; Grossman and Krueger, 1995; Mukherjee and Chakraborty, 2013), as well as its social capital and human development (Grafton and Knowles, 2004).

More recently, some authors have been interested in understanding how national culture impacts sustainability. In this regard, some research was conducted at the company level and highlighted how national culture affects managerial attitudes, beliefs, and behaviors aimed at adopting environmental management practices (Calza et al., 2016; Song et al., 2018; Thanetsunthorn, 2014). At the country level, the relationship between cultural dimensions and sustainability performance has been the subject of earlier conceptual works (Dunning and Fontanier, 2007), focused on cross-country data (Husted, 2005; Kumar et al., 2019; Parboteeah et al., 2012; Park et al., 2007) or single country data (Okolie and Okoye, 2012).

Determining the influence of culture on human behavior is not simple, as culture is a complex construct that is difficult to accurately measure. To simplify its operationalization and to allow at least some aspects of culture to be more easily applied, researchers have suggested using cultural indices, among which

the most important and used are those theorized by the Dutch anthropologist Geert Hofstede (Hofstede 1980, Hofstede 2001). This cultural model was developed from a large-scale comparison of national cultures, by reducing the complexity of culture through its split into six significant dimensions (power distance, individualism-collectivism, uncertainty avoidance, masculinity-femininity, long-term orientation, and indulgence-restraint). Although this model has some criticisms, such as the methodological assumption (the hypothesis that the national population is a homogeneous whole), it is generally considered the most comprehensive framework of national cultures and is still one of the most used in cross-cultural research.

Among the cultural variables, an important role is attributed to religion. Previous research has found that religion influences many aspects of lifestyle that affect the environment, but no studies have analyzed how it impacts the country's environmental performance. This paper attempts to fill this gap.

Religion is widely considered a cultural proxy, being a value, a social norm, and an informal institution that contains beliefs that in turn influence the attitudes of individuals (Guiso et al., 2003). Religion also helps shape legal systems (La Porta et al., 1999) and plays a key role in understanding economic growth (McCleary and Barro 2003; Guiso et al., 2006), and corporate social responsibility (Du et al., 2014; Harjoto and Rossi 2019).

For these reasons, in this study, we also include religion as a cultural variable suitable for influencing the environmental performance of a nation. To measure the environmental performance of nations, we used the Environmental Performance Index (EPI), created by the Yale Center for Environmental Law and Policy and adopted by the main literature as aligned with the Sustainable Development Goals (SDGs) of the UN Agenda 2030 and useful for assessing the country's proximity to global sustainability targets (Kumar et al., 2019; Park et al., 2007). This index provides a data-driven summary of the state of sustainability around the world, using performance indicators referring to climate change performance, environmental health, and ecosystem vitality. Additionally, in our analysis, we include socio-economic normalizers, such as GDP per capita, employment ratio, and level of education.

We investigate 96 countries around the world for 1,056 country-year observations during the period 2011-2021. The study uses a dynamic panel data model involving a two-step system-GMM (Arellano and Bond, 1991; Blundell and Bond, 1998) because it is a powerful econometric tool that captures the two

components of endogeneity, namely, that which is attributable to unobservable heterogeneity and that which is associated with simultaneity (e.g., Wooldridge, 2002, and Wintoki et al., 2012).

This paper extends the literature in at least three ways. First, we consider the relationship between a country's environmental performance and cultural dimensions including religiosity. Secondly, we use a dynamic panel two-step system-GMM (Arellano and Bond, 1991; Blundell and Bond, 1998) because it is a powerful econometric tool that captures the endogeneity issues. Finally, to the best knowledge of the authors, the sample of this work is larger both in terms of the number of countries considered and in the historical series analyzed, considering that the previous literature only carries out cross-sectional analyses, except Peng and Lin which consider only three years (Peng and Lin, 2009).

The remainder of the paper is articulated as follows: section 2 presents the theoretical background and the development of the hypotheses; Section 3 describes the dataset and methodology; Section 4 provides the results of the regression analysis, and the last section discusses our conclusions.

2 Literature review and hypothesis construction

The link between national culture and environmental sustainability has been analyzed by the main literature under many aspects. Some research was conducted at the company level, proving how national culture affects sustainability beliefs and perceptions (Tata and Prasad, 2015), environmental proactivity (Calza et al., 2016), and more broadly corporate sustainability practices (Miska et al., 2018; Ogundajo et al., 2022; Song et al., 2018; Thanetsunthorn, 2014). A large body of literature has focused on the impact of national culture on different disclosure systems, showing how corporate social disclosure levels are likely to be influenced by national cultures (Orij, 2010; Romero and Fernandez-Feijoo, 2013), in particular the integrated reporting (García-Sánchez et. al., 2013; Vitolla et al., 2019).

At the country level, the relationship between cultural dimensions and sustainability performance has been the subject of earlier conceptual works (Dunning and Fontanier, 2007), focused on cross-country data (Husted, 2005; Kumar et al., 2019; Parboteeah et al., 2012; Park et al., 2007) or single country data (Okolie and Okoye, 2012).

In this work, to understand how cultural antecedents impact a country's sustainability, we refer to the framework of cultural dimensions developed by the Dutch anthropologist Geert Hofstede (Hofstede, 1980; Hofstede, 2001). According to Hofstede: "culture works as the mental software for humans, playing a significant role in forming their ways of thinking, feeling, and acting" (Hofstede, 2001). Determining the influence of culture on behavior is not simple, as culture is a complex construct that is difficult to measure accurately. To simplify its operationalization, Hofstede has developed six dimensions of national culture, based on which we have developed the research hypotheses described below.

2.1 Power distance

This dimension expresses the degree to which there are social inequalities among people. According to Hofstede's theory: "People in societies exhibiting with a large degree of power distance to the hierarchical order in which everybody has a place, and which needs no further justification. In societies with low power distance, people strive to equalize the distribution of power and demand."

In societies with low power distance, individuals are more likely to participate in decision-making processes and feel more involved in global issues, including environmental sustainability. Conversely, in societies with high power distance, there is a greater divide between those in power and those in subordinate roles can lead to passivity towards social initiatives and debates on environmental sustainability. This means that people in such societies may be less likely to engage in discussions or act on environmental issues, due to a perceived lack of agency or influence. Several studies support the hypothesis that there is a negative relationship between power distance and environmental sustainability (Cox et al., 2011; Husted, 2005; Park et al., 2007; Peng and Lin, 2009; Parboteeah et al., 2012; Roy and Goll, 2014). Accordingly, we suggest the following hypothesis:

> *H1. Power distance is negatively related to the country's environmental sustainability.*

2.2 Individualism

Hofstede defines individualism as "a preference for a loosely-knit social framework in which individuals are expected to take care of only themselves and their immediate families [...] Its opposite, collectivism, represents a preference for a tightly-knit framework in society in which individuals can expect their relatives or members of a particular in-group to look after them in exchange for unquestioning loyalty."

Regarding the impact of this dimension on environmental sustainability, some authors argue that in collectivist cultures, individuals are more likely to cooperate toward the long-term interests of society and engage in sustainable environmental actions and policies (Park et al., 2007; Parboteeah et al., 2012). On the other hand, some authors argue that individualistic societies value personal initiatives and are better positioned to respond to environmental problems through individual environmental initiatives reinforced by pressure groups (Cox et al., 2011; Dangelico et al., 2020; Husted, 2005; Onel and Mukherjee, 2014; Peng and Lin, 2009).

From the author's point of view, individualistic societies generate a more rapid awareness of future risks and are more likely to implement sustainability initiatives through social movements that can affect government policies. Therefore, we propose the following hypotheses:

> *H2. Individualism is positively related to the country's environmental sustainability.*

2.3 Masculinity

According to Hofstede's theory: "the masculinity side of this dimension represents a preference in society for achievement, heroism, assertiveness, and material rewards for success. Society is more competitive. Its opposite, femininity, stands for a preference for cooperation, modesty, caring for the weak, and quality of life. Society at large is more consensus-oriented". Masculine cultures are more focused on achievement and competitiveness and tend to prioritize growth and profit over environmental concerns (Hofstede, 2001; House et al., 2004; Park et al., 2007; Parboteeah et al., 2012). These cultures tend to ignore future risks and believe that socially responsible actions have greater costs than benefits (Cox et al., 2011; Husted, 2005). This can lead to actions that compromise the

environment in favor of individual interests. Several authors propose that there is a negative relationship between environmental actions and masculinity, as measured by various cultural profiling methods (Husted, 2005; Park et al., 2007; Parboteeah et al., 2012; Peng and Lin, 2009). Consequently, we propose the following:

> *H3. Masculinity is negatively related to the country's environmental sustainability.*

2.4 Uncertainty avoidance

Hofstede states that: "the uncertainty avoidance dimension expresses the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity [...] Countries exhibiting strong UAI maintain rigid codes of belief and behavior and are intolerant of unorthodox behavior and ideas. Weak UAI societies maintain a more relaxed attitude in which practice counts more than principles". Countries with high levels of risk aversion tend to have a long-term outlook and are committed to the future, willing to make sacrifices to gain future environmental benefits from sustainable actions. Moreover, the deteriorating environmental conditions could adversely affect the health of society, leading to an unknown future for citizens in high uncertainty avoidance cultures. Therefore, they may be more likely to desire stable environmental conditions to reduce their risk and maintain their sense of security.

Empirical studies by Onel and Mukherjee (2014) and Roy and Goll (2014), have shown a positive link between risk aversion and environmental sustainability, indicating that more risk-averse individuals are more likely to engage in sustainable practices. We, thus, propose the following:

> *H4. Uncertainty avoidance is positively related to the country's environmental sustainability.*

2.5 Long term orientation

Hofstede affirms that: "Every society has to maintain some links with its own past while dealing with the challenges of the present and the future. Societies prioritize these two existential goals differently. Societies that score low on this dimension, for example, prefer to maintain time-honored traditions and norms while viewing societal change with suspicion. Those with a culture which scores

high, on the other hand, take a more pragmatic approach: they encourage thrift and efforts in modern education as a way to prepare for the future". Countries that prioritize short-term benefits over long-term benefits may not engage in sustainable actions unless present benefits offset the costs. In contrast, long-term-oriented societies may be more willing to incur present costs if they estimate that the future benefits of sustainable actions outweigh the costs. Therefore, the long-term orientation can lead to a greater willingness to implement environmentally sustainable practices (Dangelico et al., 2020; Roy and Goll, 2014; Parboteeah et al., 2012). Accordingly, we propose the following:

> *H5. Long term orientation is positively related to the country's environmental sustainability.*

2.6 Indulgence

This dimension refers to the culture's tendencies regarding the fulfillment of desires. According to Hofstede: "Indulgence stands for a society that allows relatively free gratification of basic and natural human drives related to enjoying life and having fun. Restraint stands for a society that suppresses gratification of needs and regulates it through strict social norms". So far, a single study in the scientific literature has investigated the link between indulgence and environmental performance, hypothesizing a positive relationship (Dangelico et al., 2020). We disagree with this hypothesis, as people living in indulgent countries are driven to engage in pleasurable activities, spending more money and consuming more resources. In our view, this approach to a fun-oriented life leads to the dissipation of resources, with a negative impact on the environment. Consequently, we assume the following relationship:

> *H6. Indulgence is negatively related to the country's environmental sustainability.*

2.7 Religiosity

Another cultural variable that could influence a country's environmental performance is religiosity. However, so far, no studies have examined this relationship, and this paper aims to fill that gap. Previous works on religiosity focus on corporate environmental practices or their level of disclosure. For instance, Terzani and Turzo (2020) find that religiosity has an impact on

environmental company disclosure, and this effect is influenced by the country's dominant religion. Other studies have examined the impact of religiosity on citizens' prosocial and sustainable behaviors, although not considering the overall effect on a country's environmental performance. In this regard, the evidence in the literature is contradictory. For example, Schwartz and Huismans (1995) found that the religiosity of devotees to the Orthodox, Catholic, Protestant, and Jewish faiths correlated positively with benevolence, tradition, and security values, and negatively with power, success, and hedonism. Saroglou et al. show that religious people highly value principles that stimulate the protection of the social and individual order (2004). In the case of the Roman Catholic Church, the pro-environmental encyclical by Pope Francis led to an increase in belief in and moralization of climate change among the faithful (Shin and Preston, 2019). In the case of the Islamic religion, the work, which is not empirical but only conceptual, of Bsoul et al. (2022) traces a close correspondence between crucial teachings in the Qur'an and the requirements for environmentally sustainable living. On the other hand, the findings of Agudelo and Cortes-Gómez (2021) prove a negative influence of religion on sustainable and prosocial behaviors.

In this paper we take into consideration the two most widespread religions in the world, Christianity and Islam, assuming the following hypotheses:

H7. Christianity is positively related to the country's environmental sustainability.

H8. Islam is positively related to the country's environmental sustainability.

3 Research Methodology

To investigate the relationship between a country's environmental performance and cultural dimensions, we build a sample composed of 96 countries, observed in the 2011-2021 period, for 1,056 country-year observations. The sample was generated by considering all countries for which EPI data was obtainable. Then, countries that lacked data for all cultural dimensions were removed. The list of countries included in the sample is provided in Appendix A.

In our analysis, we utilize EPI as the dependent variable to evaluate the environmental performance of each country. The EPI is a complex and multifaceted metric that aims to provide a comprehensive evaluation of a country's environmental performance. The index is based on a wide range of indicators that cover various environmental issues. Using 40 performance

indicators across 11 issue categories, the EPI ranks countries based on climate change performance, environmental health, and ecosystem vitality. This indicator provides a gauge at a national scale of how close countries are to establishing environmental policy targets. The EPI offers a scorecard that highlights leaders and laggards in environmental performance and provides practical guidance for countries that aspire to move toward a sustainable future.

As our independent variables, we use the six cultural dimensions of Hofstede's theory: Power Distance Index (PDI), Individualism (IDV), Masculinity (MAS), Uncertainty Avoidance Index (UAI), Long-Term Orientation (LTO), Indulgence (IND). Some studies suggest including religiosity as an additional cultural proxy of countries (e.g., La Porta et al., 1999; Guiso et al., 2003; 2006). Therefore, we also include three variables to capture the national culture by considering the predominantly practiced religion in the country. Our analysis takes into consideration the two most widespread religions worldwide, which are Christianity (CHR) and Islam (ISL). We also consider other religions, such as Buddhism and Taoism, in an aggregated manner, labeled as "OTHER".

Furthermore, in this study, three socio-economic variables have been taken into consideration as control variables: income, education, and employment. An established literature has highlighted that higher levels of income and education are associated with better environmental performance in countries. For instance, De Soto (1989) argues that poorer countries are less likely to invest in scientific research or environmental enforcement, leading to lower social and institutional capacity for environmental sustainability. Gnyawali (1996) observes that people in wealthier countries are better informed and can make greater demands on corporations for socially and environmentally responsible performance. This is because higher levels of education and income in developed countries lead to greater awareness and concern for environmental issues. Wealthier individuals and organizations also have greater financial resources to invest in environmentally-friendly practices and technologies.

As a measure of economic development, we use Gross Domestic Product (GDP) per capita and Employment Rate (ER), provided by the World Bank. In particular, the employment rate, defined as the employment to population ratio, is the proportion of a country's population that is employed. Employment refers to individuals of working age who, within a brief reference period, were involved in any activity that generated goods or provided services for pay or profit. The working-age population includes individuals aged 15 and older.

As a measure of the level of education, we use Gross Enrollment Ratio (GER) for tertiary school, which is a metric used to measure the level of participation of a given population in tertiary education. It is calculated by dividing the number of students enrolled in tertiary education, regardless of age, by the total population of the age group that officially corresponds to tertiary education. The UNESCO Institute for Statistics collects data on education from official responses to its annual education survey.

Considering the above dependent, independent, and control variables, the following equation describes our baseline econometric model:

$$EPI_{i,t} = \mu_{i,t} + \alpha_1 PDI_{i,t} + \alpha_2 IDV_{i,t} + \alpha_3 MAS_{i,t} + \alpha_4 UAI_{i,t} + \alpha_5 LTO_{i,t} + \alpha_5 LTO_{i,t} + \alpha_6 IND_{i,t} + \alpha_7 CHR_{i,t} + \alpha_8 ISL_{i,t} + \alpha_9 OTHER_{i,t} + \alpha_{10} GDP_{i,t} + \alpha_{11} ER_{i,t} + \alpha_{12} \mathrm{GER}_{i,t} + \eta_t + \varepsilon_{i,t}$$

This study uses a dynamic panel data model involving a two-step system-GMM (Arellano and Bond, 1991; Blundell and Bond, 1998) because it is a powerful econometric tool that captures the two components of endogeneity, namely, that which is attributable to unobservable heterogeneity and that which is associated with simultaneity (e.g., Wooldridge, 2002, and Wintoki et al., 2012). It addresses endogeneity problems with a set of lagged explanatory variables as instruments for the explanatory variables.

Table 1 provides a summary of the variables utilized in the study, along with their definitions and data sources.

Table 1. Variable Definitions.

Variables	**Definition**	**Source**
Dependent Variable		
EPI	Environmental Performance Index (range between 0 and 100)	Yale Center for Environmental Law & Policy
Independent Variables		
PDI	Power Distance Index (range between 0 and 100)	Hofstede's website
IDV	Individualism (range between 0 and 100)	Hofstede's website
MAS	Masculinity (range between 0 and 100)	Hofstede's website
UAI	Uncertainty Avoidance Index (range between 0 and 100)	Hofstede's website
LTO	Long-Term Orientation (range between 0 and 100)	Hofstede's website
IVR	Indulgence (range between 0 and 100)	Hofstede's website
CHR	A dummy variable that takes 1 if the prevailing religion is Christianity; 0 otherwise	CIA World Factbook
ISL	A dummy variable that takes 1 if the prevailing	CIA World Factbook

	religion is Islam; 0 otherwise	
OTHER	A dummy variable that takes 1 if the prevailing religion is another; 0 otherwise	CIA World Factbook
Control Variables		
GDP	Gross Domestic Product per capita (in logarithmic form)	Word Bank
ER	The employment to population ratio (%)	World Bank
GER	Gross Enrollment Ratio (%)	World Bank

4 Descriptive statistics and results

Table 2 provides the descriptive statistics of all variables. We find that EPI on average (median) is equal to 61.61 (62.33), still far from the score of 100, which represents an ideal level of environmental sustainability in all sub-indicators of this index. We also find the average of variables CHR, ISL, and OTHER are 0.73, 0.19, and 0.06, respectively. This means that most of the countries in our sample are linked to the Christian religion and only a smaller part compost of Muslims. Furthermore, only a marginal proportion of countries adhere to other religions, such as Buddhism and Taoism. Table 3 provides the correlation for all variables. To evaluate the presence of multicollinearity, the Variance Inflation Factor (VIF) has been calculated. We found no multicollinearity concerns based on the rule of thumb of VIF less than 10 (Curto and Pinto, 2011; Husted, 2005).

Table 2. Descriptive statistics.

Variables	**Mean**	**Median**	**S.D.**
Dependent Variables			
EPI	61.61	62.33	14.83
Independent Variables			
PDI	58.89	60.00	21.99
IDV	44.10	41.00	24.08
MAS	48.66	48.00	19.66
UAI	68.10	70.00	23.33
LTO	46.40	46.22	23.90
IND	45.00	43.30	22.01
CHR	0.73	1.00	0.44
ISL	0.19	0.00	0.39
OTHER	0.06	0.00	0.24
Control Variables			
GDP	3.97	3.99	0.65
ER	55.97	56.66	10.20
GER	54.30	56.49	26.16

Table 3. Correlation matrix.

	GER	EPI	PDI	IDV	MAS	UAI	LTO	IND	ER	GDP	CHR	ISL
GER	1.0000	0.5769*	-0.4126*	0.4754*	-0.1825*	0.1128*	0.1974*	0.1752*	-0.1977*	0.7317*	0.3763*	-0.3735*
EPI		1.0000	-0.4241*	0.5184*	-0.0251	0.0010	0.2029*	0.2165*	-0.0050*	0.5973*	0.3691*	-0.3630*
PDI			1.0000	-0.6190*	0.1446*	0.2397*	0.0433*	-0.2967*	-0.0996*	-0.5017*	-0.1875*	0.2177*
IDV				1.0000	0.0581*	-0.2424*	0.0886*	0.1449*	-0.1400*	0.5963*	0.3223*	-0.2258*
MAS					1.0000	-0.0463*	0.0248	0.0811*	-0.0422*	-0.0965*	-0.0754*	0.0135*
UAI						1.0000	-0.0219*	-0.1083*	-0.3456*	-0.0955*	0.2878*	-0.1519*
LTO							1.0000	-0.4226*	-0.0076*	0.2543*	0.0304	-0.2156*
IND								1.0000	0.2268*	0.1989*	0.3260*	-0.2768*
ER									1.0000	-0.0534*	0.1434*	-0.3092*
GDP										1.0000	0.2532*	-0.3347*
CHR											1.0000	-0.7875*
ISL												1.0000

Table 4 describes the main findings of this study. In columns 1-4, we find that PDI, IDV, MAS, and UAI are positively and significantly correlated with EPI. On the contrary, the coefficients of LTO and IND are negative and statistically significant.

Interestingly, we find that religiosity has an impact on EPI. Specifically, we find that Christianity and Islam are positive and statistically significant, while the sign of the coefficient OTHER is negative and statistically significant. This means that Hofstede's cultural dimensions and religiosity have an impact on EPI. We also find that all control variables (GDP, ER and GER) are positive and statistically significant. The results of the regression provide a partial confirmation of our hypotheses. We can accept H2, H4, H6, H7 and H8. Vice versa, we must reject hypotheses H1, H3, and H5. Overall, our results suggest that cultural dimension has an impact on a country's environmental performance around the countries.

Table 4. Results of the regression using dynamic panel data with GMM

	Expected sign	**(1)**	**(2)**	**(3)**	**(4)**
EPI_{t-1}	(+/-)	-0.096***	-0.096***	-0.104***	-0.079***
		(0.020)	(0.021)	(0.021)	(0.020)
Constant	(+/-)	-17.265***	-13.682**	-21.894***	-11.745*
		(5.813)	(5.898)	(5.793)	(6.320)
PDI	(-)	0.049**	0.042**	0.048**	0.023
		(0.019)	(0.019)	(0.019)	(0.019)
IDV	(+)	0.112***	0.074***	0.130***	0.063***
		(0.021)	(0.022)	(0.022)	(0.021)
MAS	(-)	0.028*	0.039***	0.027*	0.055***

		(0.015)	(0.014)	(0.015)	(0.015)
UAI	(+)	0.076***	0.047***	0.091***	0.037**
		(0.015)	(0.014)	(0.015)	(0.015)
LTO	(+)	-0.069***	-0.071***	-0.055***	-0.043**
		(0.017)	(0.019)	(0.017)	(0.018)
IND	(-)	-0.053***	-0.067***	-0.031	-0.041*
		(0.020)	(0.020)	(0.021)	(0.021)
CHR	(+)		3.323***		
			(0.723)		
ISL	(+)			3.100***	
				(1.120)	
OTHER	(+/-)				-7.546***
					(1.024)
GDP	(+)	15.120***	15.101***	14.703***	14.450***
		(1.172)	(1.177)	(1.205)	(1.325)
ER	(+)	0.169***	0.144**	0.210***	0.168***
		(0.054)	(0.058)	(0.056)	(0.057)
GER	(+)	0.083***	0.078***	0.094***	0.089***
		(0.018)	(0.018)	(0.019)	(0.017)
YEAR		YES	YES	YES	YES
Wald test		1.454***	1.470***	1.481***	1.641***
Sargan test		67.99	66.76	66.64	64.85
N. Obs.		1,056	1,056	1,056	1,056

Note: The dependent variable in all models is *EPI*. Note: (*), (**), and (***) indicate significance levels of 10%, 5%, and 1%, respectively. Robust Standard Errors are given in parentheses. Wald test is the joint significance of the reported coefficients. Sargan is a test of the overidentifying restrictions, asymptotically distributed as λ^2 under the null of no correlation between the instruments and the error.

5 Discussion and conclusions

The paper aims at investigating how national culture affects a country's sustainability performance, using Hofstede's cultural dimensions. Unlike previous research, this study also examines religiosity as a cultural variable that may influence a country's environmental performance.

Regarding the cultural dimensions, we highlight the positive and significant impact of power distance, individualism, masculinity, and uncertainty avoidance.

In a culture with a high power distance, there may be greater attention to sustainability at the national level, as there is greater respect for the authority and leadership of the country. This could result in more effective public policies for environmental protection and greater attention to environmental issues in government decision-making processes. Furthermore, in a culture with a high power distance, there may be greater cooperation between the government, organizations, and businesses to address environmental challenges. This could

promote the creation of public-private partnerships and the sharing of knowledge and resources to address environmental issues more effectively.

Individualistic societies, where there is a strong emphasis on the interests of individuals, tend to have better environmental performance compared to collectivistic societies. This could be because individualistic societies tend to have values that support the formation of environmental groups, which put pressure on governments and companies to be more environmentally responsible and raise awareness about environmental issues across society. This finding is consistent with previous studies conducted by Dangelico et al. (2020), Lahuerta-Otero and González-Bravo (2018), Onel and Mukherjee (2014), Peng and Lin (2009), and Vachon (2010).

The research results are counterintuitive regarding masculinity, showing a positive impact on EPI. This result may be due to certain characteristics associated with masculinity, such as competitiveness, assertiveness, and a focus on success that can have a positive influence on a country's environmental performance. For instance, competitiveness could be used to promote sustainability and environmental responsibility among companies by rewarding those that adopt sustainable environmental practices. Assertiveness could be used to promote more stringent environmental policies and ensure compliance with environmental regulations. Additionally, a focus on success could be used to promote technological innovation and the development of clean technologies.

The expected positive impact of uncertainty avoidance is due because countries that have a high level of aversion to risk often have a forward-thinking perspective and are dedicated to investing in the future. They are willing to make sacrifices in the present to reap environmental benefits in the long term through sustainable actions. This finding is in line with some previous studies (Onel and Mukherjee, 2014; Roy and Goll, 2014).

We also find that religiosity is another meaningful cultural variable to explain the country's sustainability performance. Research findings demonstrate a positive impact of Christianity. This religion can have a positive influence on individual and collective environmental behavior, thus promoting a country's environmental performance. In fact, Christian ethics promote social justice, which includes the responsibility of taking care of other human beings and future generations. The influence of Islam on a country's environmental performance is also positive. Islam, through the concept of Khalifa (the "steward" or "protector" of the Earth), could promote greater individual and collective environmental

responsibility among its faithfuls, thus contributing to improving a country's environmental performance. In fact, some majority Muslim countries have already adopted strict environmental policies and laws, such as the introduction of protected areas or the promotion of clean technologies.

Finally, the importance of religiosity as a factor that influences a country's environmental performance cannot be ignored. Religions can provide an ethical framework that promotes responsibility towards the environment and humanity, and can influence individual and collective behavior, fostering the adoption of sustainable policies and technologies.

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Appendix A.

Countries included in the study.

	Countries				
1	Albania	33	Germany	65	Nigeria
2	Algeria	34	Ghana	66	Norway
3	Argentina	35	Great Britain	67	Pakistan
4	Armenia	36	Greece	68	Panama
5	Australia	37	Guatemala	69	Peru
6	Austria	38	Hungary	70	Philippines
7	Azerbaijan	39	Iceland	71	Poland
8	Bangladesh	40	India	72	Portugal
9	Belarus	41	Indonesia	73	Romania
10	Belgium	42	Iran	74	Russia
11	Bosnia	43	Iraq	75	Rwanda
12	Brazil	44	Ireland	76	Saudi Arabia
13	Bulgaria	45	Israel	77	Serbia
14	Burkina Faso	46	Italy	78	Singapore
15	Canada	47	Jamaica	79	Slovak Rep
16	Chile	48	Japan	80	Slovenia
17	China	49	Jordan	81	South Africa
18	Colombia	50	Korea South	82	Spain
19	Costa Rica	51	Kyrgyz Rep	83	Suriname
20	Croatia	52	Latvia	84	Sweden
21	Cyprus	53	Lithuania	85	Switzerland
22	Czech Rep	54	Luxembourg	86	Tanzania
23	Denmark	55	Macedonia Rep	87	Thailand
24	Dominican Rep	56	Malaysia	88	Trinidad and Tobago
25	Ecuador	57	Mali	89	U.S.A.
26	Egypt	58	Malta	90	Uganda
27	El Salvador	59	Mexico	91	Ukraine
28	Estonia	60	Moldova	92	Uruguay
29	Ethiopia	61	Montenegro	93	Venezuela
30	Finland	62	Morocco	94	Vietnam
31	France	63	Netherlands	95	Zambia
32	Georgia	64	New Zealand	96	Zimbabwe

How Digital Innovation Became Structural: An Explanatory Case Study in the Luxury Industry

Alessandro Annarelli*

Sapienza University of Rome
Department of Computer, Control and Management Engineering
Via Ariosto 25, 00139, Rome

Fabio Nonino

Sapienza University of Rome
Department of Computer, Control and Management Engineering
Via Ariosto 25, 00139, Rome

Giulia Palombi

Sapienza University of Rome
Department of Computer, Control and Management Engineering
Via Ariosto 25, 00139, Rome

** Corresponding author*

Abstract

Recently, the positive role of digitalization capabilities in supporting organizational resilience has been stated, but there is still little empirical research focusing on how this relationship happens in practice.
This study aims to explore how digitalization capabilities can support organizational resilience through a qualitative approach. A single explanatory case study has been conducted two years after the COVID-19 pandemic in a big international company operating in the jewellery & fashion industry to identify the key practices adopted and the main digitalization capabilities developed during the emergency period.
Interesting solutions, which helped the company in facing the emergency and seizing new opportunities through digitalization, emerged from the results and include, but are not limited to: the usage of AI and automation in operations management and the introduction of a Digital Innovation Department, which significantly redesigned the organizational structure and the strategic direction.

Keywords – Digital transformation, Organizational resilience, Digitalization capabilities

Paper type – Academic Research Paper

1 Introduction

In recent decades, globalization has heavily shaped the transformations of markets, also through the development of technical, technological, and social innovations. As a matter of facts, in today's reality digitalization and digital transformation play a pivotal role in driving companies' strategies, especially if characterized by high levels of internationalization.

Specifically, digital transformation refers to the adoption of digital technologies to innovate business processes and models and to seize value creation opportunities (Kohtamäki et al., 2019). With the advent of COVID-19 pandemic, the digital transformation process of almost all companies experienced a sudden acceleration (Guryanova et al., 2021). Indeed, even if the digital transformation effort was already underway before the start of the pandemic, the latter has generated an urgent need to expand the adoption of digital tools and solutions in almost every organizational area (Rovinskaya, 2021).

The complex and turbulent context, generated by the pandemic outburst, threatened not only the success but also the stability of companies themselves, forced to pursue both innovation and survival at once. From this point of view, resilience assumes a fundamental importance, given its most common definition as the ability to resist and react to a shock and to recover after it has occurred (Carvalho et al., 2012).

Furthermore, it can be said that during the pandemic period, resilience witnessed an evolution in its key concept and characteristics, shifting towards a more complex and dynamic nature, depending on the context, and characterizing the interactions between individuals, organizations, and the surrounding environment (Kaye-Kauderer et al., 2021).

From the above considerations emerges how imperative it has been for organizations to invest in solutions that could address competitiveness while ensuring the sustainability of business over time, in a context demanding higher levels of digitalization and interconnection.

As already reported in academic literature, digitalization capabilities can represent a valid answer to these new and multi-faceted organizational issues that have emerged in the last years (Annarelli & Palombi, 2021; Dubey et al., 2023; Khlystova et al., 2022; Marshall et al., 2023; Robertson et al., 2022).

By definition, digitalization capabilities represent a set of solutions that allow firms to combine digital assets and business resources, while leveraging digital

networks (Annarelli et al., 2021), with the aim of supporting and fostering the competitiveness of firms. As a foundation of this research, we a claim that these attributes (i.e., combination of digital assets and leverage of digital networks) can also support the development of organizational resilience.

Therefore, the aim of our research is to explore how digitalization capabilities support organizational resilience, by conducting a single explanatory case study in the luxury industry. We chose this specific industry since it has been one of the most impacted by the pandemic situation, especially for what concerns the need to reconfigure and reshape business models and market channels (Achille & Zipser, 2020).

The study is structured as follows. Section 2 contains the theoretical background and provides an overview of the concepts of digitalization capabilities, organizational resilience, and the relationships between the two; section 3 describes the adopted methodology, section 4 the qualitative results and, finally, section 5 provides discussion and conclusions.

2 Theoretical background

2.1 Digitalization Capabilities

Digitalization capabilities have been defined as "organizational capabilities that allow firms to pervasively combine digital assets and business resources, and leverage digital networks, to innovate products, services and processes for organizational learning and customer value creation, and manage innovation for ensuring sustained competitive advantage" (Annarelli et al., 2021, p. 8).

These capabilities have recently acquired increasing attention for their significant role in enabling value co-creation with customers (Lenka et al., 2017), in integrating resources as a key link to open innovation (Wu et al., 2022), in enhancing digital export (Elia et al., 2021) and in providing a subsequent commercialization of data and a prolific interaction with sales and marketing functions (Ritter & Pedersen, 2020).

Moreover, capitalizing agility and operational adjustment agility through digitalization capabilities have been recognized as essential requirements to survive in the COVID-19 pandemic period (Li et al., 2022).

2.2 Organizational Resilience

Although it is commonly recognized that there is no unique definition and index to describe the multi-perspective nature of organizational resilience, research on this topic from a strategic point of view, mainly concerned how ensuring firms not just survival but successful growth, alongside a competitive advantage in turbulent times (Carvalho et al., 2012; Hillmann, 2021).

Organizational resilience has been defined as the organizational ability to face disruption or unexpected events through strategic and operational management, pursued by a static and dynamic approach (Annarelli & Nonino, 2016). This allowed for an improvement of firm performance by enhancing organizational learning through the promotion of practices such as: experimentation, risk-taking, interaction with the environment, and participative decision-making (Rodríguez-Sánchez et al., 2021).

2.3 Digitalization capabilities and organizational resilience

Recent studies, fostered by the pandemic emergency, conceptualized an important role of digitalization capabilities in the development of organizational resilience in different contexts. For instance, digitalization capabilities were associated with better organizational resilience in creative firms (Khlystova et al., 2022) and in SMEs (Robertson et al., 2022). Further, they were acknowledged to enhance other forms of resilience that concur with organizational resilience such as supply chain resilience (Dubey et al., 2023), cyber resilience (Annarelli & Palombi, 2021), and disaster resilience (Marshall et al., 2023).

However, existing research on digitalization capabilities and organizational resilience is based mainly on conceptual and review studies, leading to a lack of understanding about the mechanisms that enhance this relationship. This suggests the need for an empirical exploration on how digitalization capabilities can actually support organizational resilience.

3 Methodology

We adopted the case study methodology to consider the complex interrelation of variables characterizing the interrelationship between the push toward organizational resilience and digitalization capabilities. The case study is the preferred method to investigate an empirical topic by following a set of pre-

specified rules and procedures; it allows a holistic and contextualized analysis, properly suited for exploratory research purposes, because it allows the identification of crucial variables while exploring a given phenomenon. This research employed a single case study design because it allows an in-depth examination of the chosen phenomenon through a single informative case (Eisenhardt, 1989; Yin, 1984).

For this study, we chose an Italian company operating in the fashion luxury industry: jewellery, watches, leather goods but also accessories, perfumes, and luxury hotels. This company is a symbol of undisputed excellence, and it is a large company with high levels of internationalization. Furthermore, for about ten years it has belonged to one of the best-known groups in the industry, which is the owner of over seventy globally successful brands.

The case study has been designed to ensure a high quality of research and methodological rigor. In order to reduce possible biases, and maximize validity and reliability, the objective of the research was to diversify data collection methods and sources (Eisenhardt, 1989).

3.1 Data collection

We gathered data from primary (i.e., semi-structured interviews) and secondary sources (i.e., reports and archival data) which allowed us to understand how digital transformation occurred for the company under investigation, and to deepen the role played by digitalization capabilities. The process of data collection required about 2 months and involved mainly interviews with nine key informants. The key informants' profiles are detailed in the table below according to the order in which the interviews were conducted.

The sample consists of nine respondents who belong to different areas of the company and, sometimes, to different hierarchical positions. Mostly these are high-level managers, but there are also junior profiles who, however, have a broad perspective of the company.

Table 1. List of interviewed informants

	Key Informant
KI_1	Inventory Controller
KI_2	Events Coordination Senior Manager
KI_3	Logistics Specialist
KI_4	High Jewellery Logistics Manager
KI_5	Innovation and Transformation Director
KI_6	Innovation and Transformation Manager
KI_7	Innovation and Transformation Specialist
KI_8	High Jewellery Logistic Specialist
KI_9	Budget and Reporting Analyst

3.2 Interview protocol

The interview consists of nineteen open-ended questions, based on the work of Annarelli et al., (2021), that allowed to conduct an assessment of digitalization capabilities owned by the organization and the organizational resilience profile from different perspectives provided by the informants. More in detail, the interview covered the following topics:

Improvisation: The purpose of these questions is to understand if and how the observed company exploits improvisation to seek solutions following the occurrence of urgent situations in turbulent contexts.

- *Digital environment:* given the continuous and rapid evolution of the digital environment, these questions are used to understand whether the company correctly monitors the environment itself and the related emerging behaviours of users.
- *Digital assets:* this set of questions aims to establish whether the company can appropriately exploit the digital resources available, for example, to automate tasks or digitize processes.
- *Digitalization and strategy:* these questions are fundamental to define the relevance for the company of concepts such as digital innovation, digital leadership, and the development of IT capabilities.
- *Digital innovation habitat:* expanding the digital innovation habitat is essential for a cutting-edge company. The questions on this aspect are used to understand if the company in question pays sufficient attention to this issue and if this allows it to access otherwise inaccessible opportunities.

- *Digitalization of the supply chain:* with the questions in this section, we want to verify the goodness of data management along the supply chain and the connectivity of the latter.

4 Results

4.1 Improvisation

Although complete improvisation is not possible considering organizational constraints such as guidelines and protocols and many controls the organization is subjected to, the interviewees agree in recognizing the organization has exploited improvisation many times during the pandemic. For example, to face air and naval transports logistic problems, the firm signed agreements with partners that until then the company had yet to consider.

4.2 Digital environment

The newly introduced Digital Innovation department, born a few months after the advent of the pandemic, continuously monitors, discovers, and explores the entire digital and technological environment collaborating with the IT function and external consultancy companies.

The IT area continuously makes updates, introduces new tools, and helps the staff to use them by promoting, for example, an education portal with online courses where employees are guided in using these tools.

At the same time, the company constantly carries out data analysis to provide relevant information in support of digital innovation. Specifically, it is crucial paying attention to the various generations of users and also to the different use they make of technologies to exploit properly the digital communication channels.

4.3 Digital assets

The company uses artificial intelligence, (especially in production, logistics, and supply chain management), for object recognition. In the jewellery industry, recognizing a piece of a specific necklace that comes from a specific supplier might sometimes be a problem. The pieces that the company buys for a series generally come from different suppliers, but the necklaces are the same, so there

is a need to recognize the supplier from which each piece comes. To solve this problem, the company has created an artificial intelligence system that recognizes the incoming pieces with a high-definition camera and, consequently, manages to associate them with the correct supplier.

The company is adopting automation systems too. For example, it uses machines capable of scanning and reading the QR codes of pieces and products which are therefore recognized and correctly transferred between the various areas. Without these automated systems it would be necessary to carry out the same operations manually on the management system, generating a significant loss of time.

Digitalization in processes is almost always cost-effective for the company. During the pandemic, it was essential to adopt smart working and other methods that would allow to carry out the usual activities but "remotely". In fact, the company introduced in that period a system that has made it possible to sign contracts and invoices remotely and even more quickly, "it's much faster than searching all the corridors for signatures" (Events Coordination Senior Manager).

4.4 Digitalization and strategy

After the advent of the pandemic, great importance has been given to digitalization as an indispensable tool for creating and maintaining a competitive advantage. About this, the Innovation and Transformation Director reported:

> *"More roads have opened, now the options are open, and we go by preferences or opportunities. The important thing is that there is the opportunity today"*.

Also, in the marketing field, digital technologies have proved to be necessary to maintain the company's image and performance advertising and sponsoring events on social media.

The company continually seeks to reduce the rigidity of its organizational routines at all levels. The High Jewellery Logistics Manager explains how the goal is also to try to "*do nothing, (...) to make all work more flexible, the more the machine does, the more the mind can occupy itself with other things"*. This means that the more the machine is able to deal with repetitive tasks, the more time is let to human beings for more productive activities. This, in turn, leads to better opportunities to find improvements to processes, for instance, giving the company higher flexibility and considerable advantages. The Innovation Team

deals exactly with innovation and transformation because without transformation there is little room for innovation, and vice versa. The enterprise system is becoming more and more integrated and well-connected to ensure an effective alignment between business strategy, operations strategy, and management.

4.5 Digital innovation habitat

According to the Innovation & Transformation Specialist "*the digitalization capabilities that emerged during the pandemic period give the company many new opportunities*". With the pandemic, everything has been greatly restructured, given the need to use digitalization much more. Now the habitat is much more fluid and, therefore, with the growth of numerous factors (i.e., suppliers, production, and sales increase) the flow becomes more complicated. Digitalization increases standardization, while the environment is rapidly evolving.

In recent years the fashion-luxury industry witnessed an exponential development. The group to which the company belongs has grown by 68% compared to 2019. Online events, for example, have made it possible to reach a much wider audience than before.

4.6 Digitalization of the supply chain

The deep experience and the numerous tools available for data management allow the company to have good connectivity along the entire supply chain, as the Innovation & Transformation Director explains:

"The integration between the various areas is guaranteed, organizationally and then digitally because the company owns integrated systems", however, the expertise of the person using the management system makes the difference.

The management of cross-functional process dependencies is almost always ensured while at the corporate level, there are more difficulties, hence the group is working on improving corporate-level communication practices.

5 Discussion and conclusions

Results show positive effects of the digital transformation, introduced and incentivized by the COVID-19 pandemic, effects that have been experienced not only by the company itself but also by its entire network. The main positive effects include, but are not limited to, the quality of communication with distant

suppliers and clients due to the worldwide introduction of videoconference in the daily organizational routines and a significant organizational structure transformation. The organizational restructuring has included an essential growth of the e-commerce department and the introduction of the digital innovation department directly controlled by the innovation business unit.

The introduction of a dedicated department makes this case emblematic of how digital innovation is becoming structural after and because of the crisis time.

Figure 1 shows the key practices and solutions the company adopted during the pandemic period to develop digitalization capabilities supporting organizational resilience.

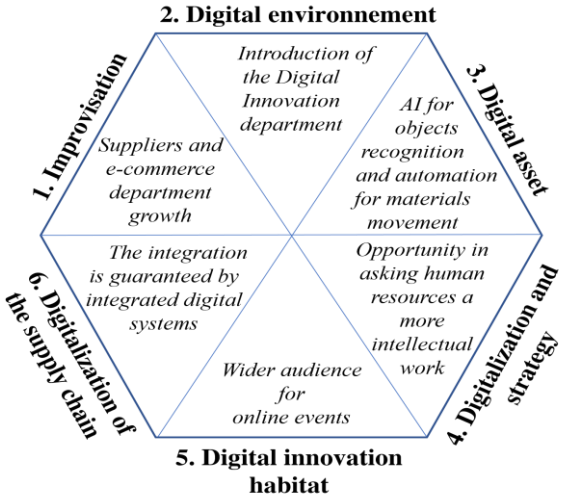

Figure 1 - How Digitalization capabilities support organizational resilience.

This research contributes to the digital transformation research field by showing the existence of a positive influence that digitalization capabilities can have on organizational resilience while focusing on an industry that has received little attention so far in this stream of research. From a managerial standpoint, implications can be derived on how to exploit more effectively existing capabilities, and eventually how to nurture new ones.

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The Digitization Process of the Poorest State on the Periphery of the European Union: Efforts and Trends

Victoria Lisnic*

Center of Political Researches and International Relations,
Legal, Political and Sociological Research Institute of
Moldova State University
Academiei street 3/2, Chisinau, Republic of Moldova

Maria Diacon

Center of Political Researches and International Relations
Legal, Political and Sociological Research Institute of
Moldova State University
Academiei street 3/2, Chișinău, Republic of Moldova

Victor Juc

Center of Political Researches and International Relations
Legal, Political and Sociological Research Institute of
Moldova State University
Academiei street 3/2, Chisinau, Republic of Moldova

** Corresponding author*

Abstract

It is contested whether or not developing countries1 can achieve economic prosperity through shifting from agricultural to industrial societies. In the face of uncertainty surrounding economic and technological development, policy makers in many developing countries formulate ambitious goals for digitalization and its positive impacts on accelerating structural change [Matthess et al, 2020]. With regards to digitalization, a wealth of studies investigates the relationship between digital technologies and their economic impacts, e.g., on productivity [Qiang et al, 2009], employment [Ju, 2014], or manufacturing [Kohtamaki, 2020].

The article is focus on the analyses of the capacity of a developing country as Republic of Moldova is to adopt and implement digitalization policies. In this regards we highlight that in recent years, the governmental e-Development efforts of the Republic of Moldova were guided by the national strategies "Electronic Moldova" (2005), the e-Transformation

1 We use the term "developing countries" to refer to low- and middle-income countries according to World Bank Classification.

program (2011), Strategy of development of the ecosystem of the IT industry and digital innovation 2018-2023 and "Digital Moldova 2020" Strategy (2013), which aims to increase the competitiveness of the ICT industry at the regional level and improve the climate for digital innovation.
Why does the information technology sector represent an engine of social innovation and multilateral development of the country?
How necessary are e-Government services for the citizens from the poorest country in Europe?
In an attempt to answer these questions, the article will emphasize that in the Republic of Moldova, the ICT sector has become the main engine of digitization and innovation, and it is growing rapidly. In 2020, the IT industry reached a share of more than 3% in GDP, the share of the ICT sector in GDP being more than 7%, and the share of innovative enterprises represents 12.6% of the total number of enterprises. The share of ICT service exports reached 5% of total trade and surpassed traditional export fields (wines, textiles, etc.) in 2020, up 23% from 2019 and 184% from 2015; the sector employs approximately 1% of the total population of Moldova. It is little, but at the same time it is a very attractive sector for young people. (Strategy, 2022) With reference to the Electronic Government Agency, it is worth to mention that from 2011 until now, more than 100 e-Governance products have been successfully created within more than 20 e-Transformation and modernization initiatives of public administrative services, building a sustainable platform for the modernization public services and other innovations in governance.

Keywords – digitization, e-Government, innovation, services, development

Paper type – Academic Research Paper

1 Introduction

At the European Union level, one of the six priorities of the European Commission envisages the digital transformation of Europe by 2030. The priority "A Europe fit for digital age" (2019-2024) evolves around four cardinal points: Basic digital skills for min 80% of population; Digital transformation of businesses; Digital infrastructures; Digitalization of public services (key public services - 100% online). Effective enforcement of these rules will fundamentally influence public sector innovation in the coming years, so that they become a reality for citizens and businesses.

For the Government of the Republic of Moldova, one of the new activity priorities is the deep digital transformation of the country, at all levels. Digital transformation is mentioned as a priority in the government program of the current executive, including by establishing, for the first time, a position of deputy prime minister for digitization, with the aim of coordinating all efforts in the

reference field at Government level and, in particular, of the most important specialized institutions of the department: the Electronic Government Agency (AGE), the Public Services Agency (ASP) and the Information Technology and Cyber Security Service (STISC).

2 The information technology sector as an engine of social innovation

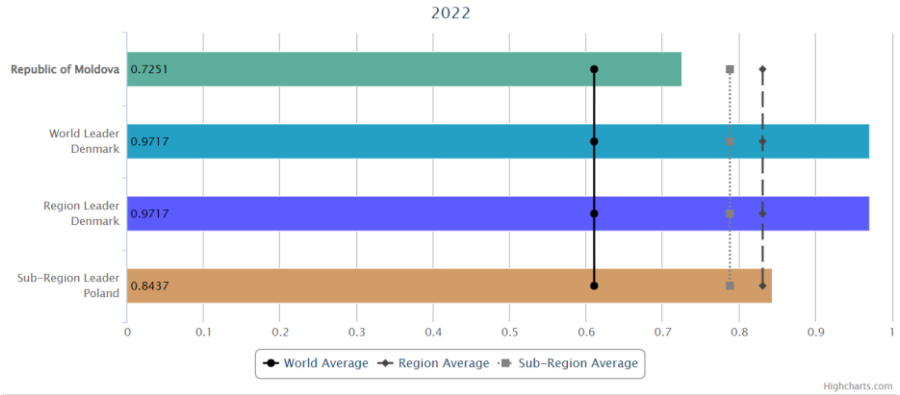
Innovations in technology are increasingly impacting on almost every sector in the economy and all facets of humanity and society. [Oke & Fernandes, 2020] Industry 4.0 is advancing rapidly, and the Covid 19 pandemic crisis has changed digital transformation from a priority to a global imperative. Today, digitization is a pressing necessity and has enormous potential in solving the challenges facing Europe and the world at large. It is not for nothing that the European community is making significant efforts to prepare its businesses and citizens for a sustainable, more prosperous and human-centered digital future.

The digital transformation is an imperative of the time in all sectors of life and in all fields of activity of all states of the world, including the Republic of Moldova. For the Republic of Moldova, the digital transformation based on new technologies leaves no alternatives, other than active involvement in this process, in order to avoid the country falling behind in the competition at the regional, European and world level. The deep digital transformation has been declared a strategic priority, being a strong component of the current Government Program for the next four years. "Promoting digital tools in the economy and society; exclusion of the mandatory presentation on physical support by citizens and entrepreneurs of the documents issued by the authorities; implementation of automated public services, without the need for their explicit request, simplifying the interaction with the state".

The implementation of the strategies "Electronic Moldova" (2005), "Digital Moldova 2020", the "e-Transformation" programs, other policy documents, led to the creation of a solid infrastructure with a coverage of 99% of the population with Internet access. Half of public service users access services electronically and 127 out of 662 public services are accessible electronically. The ICT sector has become an engine of development, surpassing in the volume of exports traditional branches such as that of winemaking (the share of ICT service exports reached 5% of the total trade or 23.8% of the total export of services). During the

last 5 years the electronic communications market has had a period of dynamic competitive growth, positioning the country among top destinations on the dimension of high-speed Internet, accessibility. Comparing the share of the IT sector in GDP in 2020 of around 3.6% with that of 0.8% in 2013, when the IT sector was declared a policy priority, the dynamics are remarkable. A dedicated policy and legislative framework for information technology and digital industries has played a central role in its remarkable and dynamic evolution. The special fiscal regime of the 7% tax on single turnover, offered by the legislation to the virtual IT park in Moldova and the wide range of eligible activities, including research and development in the field, gave a significant boost to the development and caused an increase of four times between 2015-2020, surpassing the telecommunications sector.

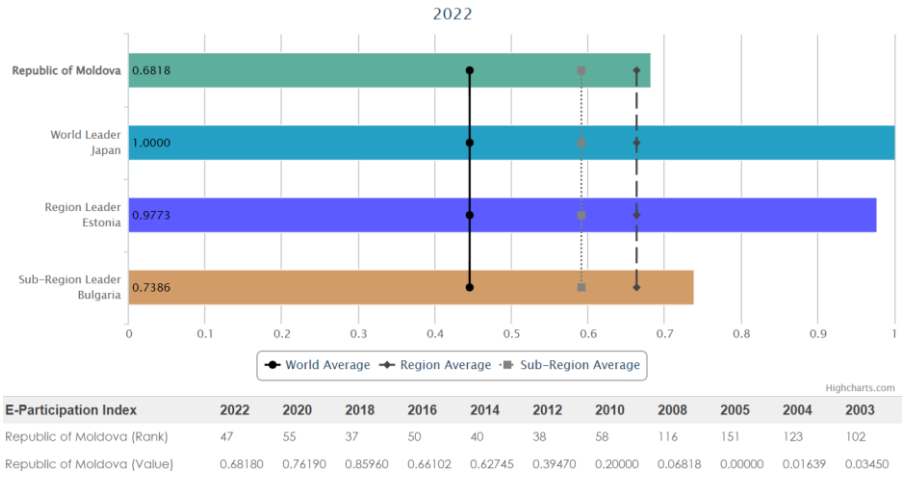
Although many positive results were obtained, the UN E-Government Knowledgebase survey [5] on the e-Governance Development and e-Participation Indices, for the year 2022, placed the Republic of Moldova on 72nd and 47th place respectively out of 193 countries (fig.1,2)1, this being below the average of the EU and all Eastern Partnership countries, which means that additional efforts are needed to keep the country competitive on the dimension of digital development.



E-Government Development Index	2022	2020	2018	2016	2014	2012	2010	2008	2005	2004	2003
Republic of Moldova (Rank)	72	79	69	65	66	69	80	93	109	106	95
Republic of Moldova (Value)	0.72510	0.68810	0.65900	0.59945	0.55708	0.56260	0.46114	0.45100	0.34588	0.34457	0.36325

Figure 1: E-Governance Development Index

1 Source: UN E-Government Knowledgebase. https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/139-Republic-of-Moldova



E-Participation Index	2022	2020	2018	2016	2014	2012	2010	2008	2005	2004	2003
Republic of Moldova (Rank)	47	55	37	50	40	38	58	116	151	123	102
Republic of Moldova (Value)	0.68180	0.76190	0.85960	0.66102	0.62745	0.39470	0.20000	0.06818	0.00000	0.01639	0.03450

Figure 2: E-Participation Index

The final report on the implementation of the Action Plan of the "Digital Moldova 2020" Strategy mentions that "there are positive developments in creating the conditions for the implementation and use of electronic services, the development of digital skills; the legal framework was created to improve connectivity and network access, removing critical constraints on the ICT business environment. At the same time, there have been certain delays or failures in the implementation process of the Strategy and the Action Plan, a series of challenges and problems persist, caused by both objective and subjective circumstances: insufficiency of material and financial funds, insufficiency of resources qualified human, delays and inactions. The biggest challenge being the lack of financial resources"[6].

With the conclusion of the "Digital Moldova 2020" Strategy in 2020, appeared an urgent need to rethink a new digital transformation strategy, with a "*whole society*" approach, i.e., with the involvement of citizens, central and local public administration, academia and the private sector, for whom, according to [Savić, 2019] digital transformation means doing things differently — creating a completely new business model by using modern information and IT technologies.

The Concept of new Digital transformation strategy of the Republic of Moldova for the years 2023–2030 (STDM, 2030) it is a citizen-centered document aimed at improving people's well-being. The basic mission of the strategy is to achieve effective public governance, competitiveness and innovative transformation of

the economy and society, i.e., innovative and inclusive digital society, based on a modern infrastructure with digitally educated people, pro-digital governance, a business community that fully uses digital opportunities, as well as a collaborative environment for stakeholders that encourages the innovative work of all people and ensures sustainable human development. The aim of the strategy is not only to transform all public services into digital space, but to rethink and redesign them where possible, reducing the need to submit requests or information that the state already knows. The strategy will also address ways to ensure a secure cyberspace, which will contribute to improving the socioeconomic development of the Republic of Moldova, so that all citizens of the country can enjoy all the benefits of a secure and resilient cyberspace. Generalizing, the most important objectives of the Digital Transformation Strategy 2023-2030 are as follows: creating a functional digital state by limiting to the maximum the interference with the human factor, bureaucracy and corruption; creating an interconnected digital state (especially with the European community) by participating in the strongest global networks in the digital field; the development of a digital society through education on a national scale – a process in which the authorities at different levels must be involved; building the national digital infrastructure; strengthening the ICT private sector; cyber security, ensuring the protection of personal data, but also of the information space in the context of events in the immediate vicinity (Russia's war against Ukraine); boosting the digital economy by capitalizing on the opportunities offered by digitization, the substantial increase in electronic payments and online commerce (STDM, 2030)

The consistent and punctual implementation of STDM 2030 in the context of the Republic of Moldova's aspiration to full integration into the global communication system and to join the EU is crucial and therefore requires a visionary and realistic approach.

3 The necessity of e-Government services for citizens

How necessary are e-Government services for the citizens from the poorest country in Europe?

In an attempt to answer these questions, we highlight that in the Republic of Moldova, the ICT sector has become the main engine of digitization and innovation, and it is growing rapidly. In 2020, the IT industry reached a share of more than 3% in GDP, the share of the ICT sector in GDP being more than 7%,

and the share of innovative enterprises represents 12.6% of the total number of enterprises. The share of ICT service exports reached 5% of total trade and surpassed traditional export fields (wines, textiles, etc.) in 2020, up 23% from 2019 and 184% from 2015; the sector employs approximately 1% of the total population of Moldova. It is little, but at the same time it is a very attractive sector for young people. (MobiSign, Strategy, 2022) With reference to the Electronic Government Agency [2], it is worth to mention that from 2011 until now, more than 100 e-Governance products have been successfully created within more than 20 e-Transformation and modernization initiatives of public administrative services, building a sustainable platform for the modernization public services and other innovations in governance. Among the most popular e-services created and managed by AGE are: Government electronic payment service MPay, Electronic signature service MSign, Government interoperability platform MConnect, Government authentication and authorization service MPass, followed by the newest platforms recently launched: MCabinet , MPower, MNotify, etc. The beneficiaries of the e-Transformation products are the citizens and visitors of the Republic of Moldova, the business environment and public institutions.

The mpay.gov.md electronic payment platform (MPay) is the government's electronic payment service, an informational tool that can be used to pay for various online services. Although MPay is primarily aimed at public sector e-services, it can also be successfully used for commercial services. MPay makes it possible to pay for services through several payment methods such as: bank cards, payment terminals, e-banking systems and cash payments. In the case of cash payments, citizens who do not have access to the Internet can contact connected bank counters or Moldovan Post Offices.

Beneficiaries of the MPay service are primarily citizens, those who pay for public services, but also representatives of the business environment, who in their commercial activity need to receive payments for the services provided, but also to pay for the services consumed.

Cardholders can make electronic payments for public services. The payment of the consumed services can be made with any legal payment instrument available on the market in the Republic of Moldova. The payment scenario is simple. Access the e-Service on servici.gov.md and complete the online application. The service will calculate the amount to be paid and propose payment via MPay. the user will be redirected to the mpay.gov.md site, where he will be able to select the payment method and make the payment. At the end of the operation, the service

will come with a payment confirmation. At any time, the user can check the payment status.

Offline services can also be paid through MPay, which can be ordered at the counter of public institutions. For this, access the mpay.gov.md page, select the service and enter the number of the order, request or report, after which the payment is made in the same way as at the payment terminals.

The MPay service is carried out by the Government through the Electronic Government Agency, the Information Technology and Cyber Security Service, the Ministry of Finance in partnership with the National Bank and the private banking sector. This service is in accordance with the policies of the National Bank promoting cashless transactions.

Government e-payment service MPay has been awarded the 2022 "Digital Transformation Driver" award at "Mastercard Day 2022". [7]

MSign is the government electronic signature service, created by the Electronic Government Agency, which offers the possibility of using all types of electronic signatures in online interactions and verifying the authenticity of signatures under conditions of guaranteed security.

The Electronic Government Agency recommends the use of the MSign Service as a method of applying and verifying the authenticity of the advanced qualified electronic signature. The MSign service is hosted on the common government platform MCloud and complies with the security requirements provided by the legislation in force, including the use of electronic signatures. The informational exchange between the informational systems for the realization of the functionality of the MSign service is carried out through secure channels, using cryptographic information protection mechanisms. Through MSign it is possible to sign with the 3 tools available: Mobile Signature, Electronic Identity Card and Electronic Signature (STISC). Benefits of using:

- It offers the possibility to access electronic services remotely instead of going to the counter;
- Eliminates the need to print documents just to be signed;
- Ensures data privacy and security.

Citizens of the Republic of Moldova can receive documents and other documents requested from state institutions at their place of residence, through the Governmental Delivery Service (MDelivery), which was developed based on the Concept approved by the Government on August 25, 2021 and the

Regulation on the manner of operation and use of the MDelivery Service, approved on March 23, 2022.

The service was launched on July 29, 2022 and aims to offer authorities, public institutions and public service providers an efficient, reliable and modern technical solution, to be used as a unique mechanism for the physical delivery of the results of the provision of public services to the beneficiaries.

The MDelivery information platform (www.mdelivery.gov.md) was developed by connecting the three subjects: the public service provider, as the sender, the public service beneficiary, as the recipient of the delivery, and the postal service provider. This platform will reduce costs for all three parties involved and will streamline the process of delivering the result of the public service to the beneficiary. People can request the delivery of the ordered document to their home address from the operator at the counter of the service provider institution, or they can access the mdelivery.gov.md platform and follow the steps described to order the delivery of the document. [9]

The government electronic notification service MNotify is the way in which state institutions can notify and inform users of public services about important events in relation to the authorities, sending messages through different notification channels of the user's choice. These messages refer to debts, fines, discharges, payments, allowances, allowances, etc. that citizens have to perform to the state and/or vice versa.

Through this electronic service mnotify.gov.md, the citizen is informed (notified) by public institutions about certain services provided by the state, without this service being requested by the beneficiary. Beneficiaries can be both natural and legal persons. The government electronic notification service MNotify was launched in November 2020 and is integrated on the Citizen's Government Portal, and users receive the electronic notification including through the mcabinet.gov.md portal.

In MNotify, notifications can be generated automatically by information systems or manually by operators of service providers through the web interface. To send notifications, MNotify uses the following notification channels: electronic mail (email), the citizen's portal, push notifications, short messages (sms), instant messaging (chat) The MNotify service is provided free of charge to Senders (public authorities and institutions) as well as to Recipients.

Digital transformation is no longer a specialized, niche field. This represents an imperative of the time in all sectors of life and in all fields of activity of all states

of the world, including the Republic of Moldova. Any field can and must benefit from the advantages of modern technologies, simplifying or eliminating bureaucratic procedures, reducing dependence on the human factor, avoiding repetitive and purely technical procedures, excluding corruption factors and increasing trust in state institutions.

4 Conclusions

The results of the research paper show the positive aspects and the challenges faces by a developing country, as the Republic of Moldova is, in the process of digitalization. For sure, there are many positive elements in creating the conditions for the implementation and use of electronic services, as the development of digital skills, creation of the legal framework to improve connectivity and access to the network, the removal of critical constraints on the ICT business environment. At the same time, there have been recorded certain delays or failures in the implementation of the digitalization process, a series of challenges and problems persist, such as: insufficient material funds, insufficient qualified human resources, delays and inaction or the lack of financial resources.

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Knowledge Documentation and Storage as a Key Challenge of Knowledge Management Implementation in Small and Medium-Sized KIBS Companies

Enrico Scarso*

Department of Management and Engineering
University of Padova
Stradella S. Nicola, 3, 36100, Vicenza, Italy

Ettore Bolisani

Department of Management and Engineering
University of Padova and Venice International University
Stradella S. Nicola, 3, 36100, Vicenza, Italy

Tomas Cherkos Kassaneh

Department of Management and Engineering
University of Padova
Stradella S. Nicola, 3, 36100, Vicenza, Italy and
Bahir Dar Institute of Technology, Bahir Dar University, Bahir Dar,
Poly-peda 01 0026, Ethiopia

** Corresponding author*

Abstract

Knowledge Intensive Business Services (KIBS) companies have long been recognised as key players in the modern economy since they positively affect the innovativeness of businesses and societies. Their business activities are mainly based on knowledge, which is both the input and the output of their production processes. Despite their small average size, the vast majority of KIBS companies are aware that knowledge is their most crucial competitive resource. However, they often manage their cognitive assets in a substantially informal and undeliberate way. Indeed, such companies face difficulties and obstacles typically associated with a limited size, such as, e.g., scarcity of human and financial resources, lack of time, and short-term orientation. Furthermore, KIBS SMEs face specific challenges, mainly caused by the intangible and knowledge-intensive nature of their business processes. A key issue concerns knowledge documentation and storage, which is essential to make the retrieval and reuse of possessed knowledge easier for existing and newly hired employees.

In spite of the above, research about how small and medium sized KIBS companies manage knowledge documentation and storage processes is still limited. To help fill this gap, this paper examines the main difficulties that KIBS SMEs face when documenting and storing their knowledge and how they try to face and overcome these difficulties. In particular, the paper illustrates and discusses the findings of an empirical investigation that involved 13 Italian KIBS SMEs belonging to different sectors. The decision to adopt a multiple case study approach was induced by the exploratory nature of the research. The study revealed that knowledge documentation and storage is a widespread activity among the investigated companies, which confirms the relevance of these processes. The investigated companies are aware that poor documentation generates several problems that result in late responding to client requests. Furthermore, the study allowed identifying some shared challenges that concern the entire document and storage process, as well as collecting useful indications about how companies deal with them. The study has the usual limitations of a case study methodology, and especially the difficult generalisation of the results. This paves the way for future research devoted to confirm what emerged from the present analysis, for example, by means of surveys.

Keywords – KIBS, Knowledge documentation, Knowledge storage, Knowledge management challenges, Case study

Paper type – Academic Research Paper

1 Introduction

Knowledge Intensive Business Services (KIBS) companies are unanimously recognised as key players in modern economies (Kamp and de Apodaca, 2017; Pina and Tether, 2016; Tuominen and Toivonen, 2011). In particular, they are deemed to exert a positive influence on the innovativeness of businesses and societies (Liu et al., 2019; Shearmur and Doloreux, 2019). As the name suggests, KIBS companies base their competitiveness on knowledge (Miles et al., 2018; Palacios-Marques et al., 2011), which is both the input and the output of the service delivery process (Strambach, 2008). The KIBS sector includes companies providing a large variety of services that the literature subdivides into three categories, i.e., technological KIBS, professional KIBS and creative KIBS (Miles et al., 2018). KIBS companies can be also distinguished according to their knowledge base (analytical, synthetic, symbolic, and interpretive; Krupskaya and Pina, 2022), i.e., the different mix of tacit and codified knowledge that denotes their cognitive processes. In addition, the large majority of KIBS companies have a small and medium size (Zieba, 2021).

Empirical evidence (Bolisani et al., 2022) proves that KIBS SMEs are aware that knowledge is their most crucial competitive resource that would be to be adequately managed. However, despite this awareness, these companies manage their cognitive assets in a substantially informal and undeliberate way (Bolisani et al., 2016; Alexandru et al., 2020). Indeed, as well underlined by the extant literature (Massaro et al., 2016; Durst et al., 2022; Shekhar and Valeri, 2023), SMEs meet with several difficulties and obstacles to managing knowledge, largely due to their limited size (e.g., scarcity of human and financial resources, lack of time, short-term orientation). KIBS SMEs face increasingly specific challenges, mainly due to the intangible and knowledge-intensive nature of their business processes and outcomes. These challenges, when not successfully identified and faced, can negatively impact firm competitiveness.

A key issue concerns the process of knowledge documentation and storage (Anand, and Singh, 2011; Zbuchea et al., 2023). To build and manage the "organisational memory" efficiently and effectively, KIBS companies are requested to implement appropriate approaches and tools to guide employees in the memorization of information and experience acquired in previous projects and, more generally, in the business activities. This makes the retrieval and reuse of the knowledge possessed easier for existing and newly hired employees. Documented knowledge includes lessons learnt, guidelines, customer databases, project reports, procedures, and so on. Effective knowledge storage requires the continuous maintenance and updating of the knowledge repository, in order to avoid the presence of obsolete, useless, if not harmful, knowledge.

In spite of this, research about how small and medium sized KIBS companies manage their knowledge in general, and particularly the knowledge documentation and storage processes, is still limited (Bolisani et al., 2022). In light of the above, this paper poses the following research questions:

RQ1: What are the main challenges that KIBS SMEs face when documenting and storing their knowledge?

RQ2: How do these companies try to face and overcome such challenges?

To answer the research questions, in the next sections, the findings of an empirical investigation that explored the main challenges in knowledge documentation and storage processes that KIBS SMEs face are illustrated.

2 Knowledge documentation and storage in KIBS SMEs

In the knowledge management (KM) literature, different taxonomies of KM processes have been published (Heisig, 2009; Andreeva and Kianto, 2011; Edwards, 2015; Costa and Monteiro, 2016). Knowledge documentation and storage is generally indicated as one of the key KM processes. Knowledge documentation, in particular, is the process of codifying knowledge into written, audio, visual, and/or video assets (APQC, 2020). Why to document and store an organisation's knowledge? The safest and most straightforward way to preserve organisational knowledge is by documenting it. Otherwise, critical knowledge is at risk when it is only stored in employees' heads. When knowledge is in the form of content, documented, and stored, it can be transferred to others at any time and is safely secured should it be needed in the future. Also, all the knowledge that has been acquired, created and shared, has to be supported by knowledge documentation and storage; otherwise, a company will be in danger of accidentally losing the gained knowledge (Andreeva and Kianto, 2011).

The special importance of knowledge storage has been earlier emphasised by many authors. Wexler (2002) argues that knowledge created within an organisation needs to be documented and stored for intellectual capital to develop and accumulate. Probst et. al., (2000) describe memory as "a system of knowledge and skills that preserves and stores perceptions and experiences beyond the moment when they occur, so that they can be retrieved at a later time." In this regard, studies highlight that an organisation's ability to store knowledge has important consequences for its performance (Olivera, 2000) and the stored knowledge can effectively safeguard the organisation from the distracting effects of turnover (Argote, et al., 1990). Thus, being knowledge as a crucial resource, companies recognize the value of knowledge storage process for present and future use as it seems to be a major building block in implementing knowledge management by re-using and facilitating knowledge creation and transfer (Jasimuddin, 2005; Zawaideh et al., 2018).

Andreeva and Kianto (2011) showed that all knowledge processes (i.e., knowledge creation, intra-firm knowledge sharing, external knowledge acquisition, and knowledge documentation) have a beneficial impact on innovation. But they especially pointed out that activities aiming at documenting and storing knowledge available within an organisation, sharing it via intra-firm interactions, and supplementing it with external knowledge acquisition provide

material for and facilitate knowledge creation processes of knowledge-intensive organisations. Another study (Ramadan et al., 2017) confirms, based on an empirical study on knowledge workers in the Knowledge intensive business services (KIBS) sector, that knowledge documentation and knowledge transfer emerged as having the strongest effects on intellectual capital (IC).

KIBS SMEs are strongly related to knowledge, since it is their most valuable resource (Zieba, 2021; Bolisani et al., 2022; Zbuchea et al., 2023). As stated by Miles et al. (1995), KIBS companies are characterised by a unique mix of knowledge associated with particular domains, applications of technology, and knowledge associated with KIBS' clients. Therefore, KIBS companies face different and various challenges related to all the diverse KM processes, and, among these, documenting and storing knowledge represent a very critical challenge (Zbuchea et al., 2023). The process of documenting and storing knowledge is a critical business activity, particularly in the case of KIBS SMEs, where there are often more tasks than people and time available to accomplish them. Also, the challenges faced by KIBS SMES, in relation with knowledge documentation and storage process, may need to be managed by adopting different KM approaches depending on the specific case and situation of a company (Zbuchea et al., 2023).

3 Research Method and Procedure

Given the exploratory aim of the research, we chose to use a qualitative multiple case study method. Indeed, due to the shortage of previous research on the analysed topic, an exploratory approach was deemed essential (Eisenhardt, 1989; Yin, 2018). The object of each case study was to examine the challenges raised, and the relevant countermeasures adopted, in the knowledge documentation and storage processes carried out in the single small and medium-sized KIBS company. Data were collected by means of deep semi-structured interviews with managers and/or owners (referred to as "key informants") of a sample of KIBS SMEs located in Italy, and specifically in the Veneto region. In particular, we used a "convenience sampling" which is a popular approach (Pham and Ho, 2017; Zhang and Liu, 2021) in exploratory and descriptive research. The sample consisted of 13 KIBS SMEs belonging to different sectors (ICT services, professional services, consulting services, legal and administrative services). The interviews were carried out between May and September 2022 and were based on a semi-structured questionnaire sent in

advance to the interviewed people. The interviews were recorded and then transcribed for scrutiny and collated with field notes and information available on company websites and other media sources. All this supported the validation of the data obtained, as suggested in the literature (Suter, 2011). To perform the analysis, an Excel file was created in which all answers were reported. This helped researchers compare the data, find similarities or differences, and draw conclusions (Miles and Huberman, 1994).

Table 1 shows some basic information about the companies in the case (business services sector and number of employees), whose names are disguised for confidentiality reasons. The sample includes both technological and professional KIBS companies.

Table 1: Sampled companies

Company	Sector	Size
A	ICT (software)	20
B	Business consulting	8
C	ICT (software)	60
D	Business consulting	60
E	Legal/administrative consulting	60
F	ICT (data management)	6
G	Strategic consulting	15
H	ICT (ERP systems)	150
I	Legal/fiscal consulting	60
L	ICT (business software and consulting)	35
M	ICT (software)	40
N	ICT (software)	30
O	ICT (system integrator)	86

4. Results and discussion

4.1 Identified challenges and practical solutions

Knowledge documentation and storage resulted to be widespread activity among the investigated firms since it deemed crucial for their business, as a company affirmed:

Very crucial. Since 1998 we have established that any document produced in the company, a letter, an email, a bid, a ticket, an appointment, any activity (activity means document) must be archived.

According to another company:

The company "beating heart" is the company's management system, which is supported by the document management system, which collects all our knowledge.

Knowledge documentation and storage mainly concern the services provided to individual customers (as e.g., the implementation of a business analytics platform, the provision of a fiscal advice), and particularly all the activities performed and the outcomes achieved during the service providing process; a typical example refers to all the documentation produced during the provision of a new software program to a client company, from the first contact to the final version and then the maintenance interventions.

Therefore, it is not surprising that such activities raise several challenges, as is confirmed by another company:

The pool of documented and stored knowledge can be regarded as a library, and therefore its effective management requires answering several questions, as follows: How should the documentary material be organised? How to inform people about new material? How to induce people to contribute with new material? How to improve the readability of the material?

The above questions can be regarded as specific challenges that KIBS companies have to face and overcome when documenting and storing their knowledge.

Organising documented knowledge is primarily a matter of classification. However, as unanimously highlighted by the companies investigated, classifying documents is an arduous task:

Classifying documents is not easy. First of all, it requires time, especially if you want to classify old material. Second, it is not simple to interpret what it is written, given that different classification logics could be applied to the same document. In this respect, a tool that allows (or obliges) to classify the document when you save the file could be of help.

The large majority of companies use to classify their documents by customers, and secondly according to technology (e.g., business intelligence), topic (e.g.,

merger and acquisition), industrial sector (e.g., beverage), or other specific aspects, but they are aware that this is not the best solution:

> *This is a simple way of classifying documents, but it doesn't facilitate the search of a particular document. Who search for has to know for which client the problem he/she is interested in was faced and solved in the past*

This is why, several times, employees have to ask colleagues, who in the past have used/produced the knowledge they need, where to look for, before they can start to search. Almost all the companies use internal databases (also on cloud systems) where the documents are stored in different folders. The currently used systems allow searching within the whole database using keywords, but for the previously recalled reasons, such searches are not so effective.

Classification is made more arduous by the fact that companies have a lot of documents stored in different formats:

> *This material can have various formats, e.g., texts, photos, videos, audios.*

and concerning different topics:

> *(there are) distinct kinds of knowledge inside the same company: those produced by the company – a sort of object (as e.g. during the service delivery process, and that can usually be stored); and those concerning the service delivery process (as e.g. guidelines, tools, approaches, which can be partially stored in procedures, but is a part of the individual skills).*

The second challenge concerns how to ensure that employees will be updated on the new knowledge that has been stored and that can be of their interest. As a company indicated:

> *… knowledge is like a splendid library, it has many compartments, you can hardly stay up to date on everything*

A solution, employed by a company, is to have a "librarian" who manages the system and regularly (weekly in that case) informs employees of the new available knowledge. However:

> *It is very expensive to have a person who is in charge of controlling the produced documents.*

Some companies usually organise regular meetings where people are updated about the projects in progress, and this is a way to make all employees informed about the new knowledge being produced and then documented.

Another challenge that is considered critical for most companies is how to induce employees to document knowledge promptly, i.e., as soon as they have completed an activity, in order not to forget important aspects. This is affected by

the reuse (of the documented knowledge) time, i.e., how long it will take before someone needs to use such knowledge. A company affirmed:

> *In case it (reuse time) is long, it is difficult to convince people to document knowledge that they will not use in the future because they probably will not still be in the company.*

and another company added:

> *If there is no immediate return you don't do it.*

Furthermore, employees do not always realise the importance of documenting what they do, as well illustrated by the following:

> *The main problem is that people sometimes are not so diligent in documenting their work, especially when things are done and taken for granted. I do an activity, and I do not pose myself the problem of making it common knowledge.*

Getting people to document the knowledge produced during their work is even more difficult in the case of technicians or sales agents, who normally are rather reluctant to write down and document their activity, since they prefer to devote their efforts and time to more practical and operative activities, and also because they regard knowledge as a source of power, as a company stated:

> *The sales force prefers to keep information so they can manipulate it to their advantage.*

To face this challenge, several companies are resorting to procedures and tools that involve the automatic generation of documents during the work. This is the case of a company that has always resorted to advanced document management software systems by requiring their employees to use them. Other companies try to induce employees to work only online (i.e., using systems like Google Drive, Share Point) since this allows the automatic documentation of the work done. To sum up, companies agree on the fact that:

> *An ideal solution would be to automatise the documentation activity to make it a "natural" part of daily work*
>
> *and that it could be necessary:*
>
> *… to have something that allows for the automatic generation of documents during the work.*

The last challenge concerns the ways of documenting knowledge, which has an impact on its usability. According to the companies investigated, documents are very often written in such a way that their content is difficult to read and understand. This in particular concerns new hires:

> *They (young people) are "tinkerers", but (don't like) writing … people no longer know how to write, and this is another kind of problem. Also write using words. There are people who write completely differently. They write in a "Whatsapp" style, or something like that. Vowels are missing, things are missing, they really write like this, and this is not good. A little classical education would be good for everyone.*

Furthermore, the investigated companies affirmed that it is not so easy to create a communal writing standard because everyone, regardless of their education level, has their own specific writing style. Additional problems are raised by the fact that different people use different languages, jargons. This problem worsens as the areas of specialisations inside the company (as well as the number of people) increase. It is not only a question of different educational backgrounds (as e.g., when business economists have to interact with computer engineers) but also of different application/technology areas (as e.g. systems engineers and software developers). The situation is well illustrated by a company:

> *Technicians speak a different language than economists. … Computer scientists from economists. Then the deeper you get into the knowledge, the more the glossary is different.*

Companies are adopting different approaches to face such challenges. As far as the writing style, training and checking-up the first written documents of new hires are ways get people used to writing something easily understandable, as confirmed by a company:

> *To make them (the documents) readable, those produced by a new hire are corrected until he/she learns how to write them properly.*

This is quite an expensive solution, especially because it requires that a senior employee devote some of his/her precious time to this.

Another solution can be to provide people with structured formats that they have to fill in, which is generally facilitated when using a document/content management system. For example, a company introduced a standard format for email to ensure its traceability. Another sends mails only by means of their document management systems, which implies their automatic documentation. As concerns the use of different languages, terms, many companies are trying to establish a sort of (more or less formal) common vocabulary, with terms having a shared meaning, and this is done by means of meetings where people of different areas talk together.

To sum up, the solutions the companies adopt to have useful content are "ex-ante" solutions, because they don't provide for checking the produced documents. So their effectiveness is questionable, as confirmed by what a company affirmed:

> *The format of the document is not free, anyway the interpretation, or the way of writing is not unique. We cannot have people who read what has been written every day. So, we assume it is done right. We gave rules to write documentation, but not everyone reads it. In any case, it is too expensive to control the content of all the stored documents, and we would not want to take the risk of stressing employees (by strictly controlling what they write).*

Lastly, it deserves to be mentioned that the identified challenges are of different relevance for the different companies, in relation to some specific factors as e.g., managerial style, company's story, organisational structure and size, kind of delivered service. The latter, in particular, seems to assume a decisive weight, as it defines the knowledge base of the company, and therefore affects the way its knowledge is managed. Therefore, it is not surprising that ICT companies have affirmed that they have been able to document their knowledge in a greater part compared to what law and administrative consulting companies were able to do.

4.2 Discussion

What emerged from our study confirmed that knowledge documentation and storage is a crucial activity for KIBS firms and raises a lot of difficulties in overcoming these challenges. Poor or lack of knowledge documentation is due to four key issues/challenges, as follows.

- Employees are reluctant to document knowledge, for many reasons: lack of time, individual attitudes, professional role, feeling of usefulness.
- "Knowledge libraries" are often badly organised, and documents are not well classified.
- The writing style of people and the heterogeneity of languages make documents difficult to read and understand.
- Documented knowledge must be updated and people must be kept up-to-date with new documented knowledge.

To face the above challenges, the investigated companies are resorting to various solutions involving actions on both the technological and human side, as e.g. using more sophisticated document management systems or helping people to develop a common language. Although the two dimensions are deemed both important, the empirical investigation has highlighted that the second is even more important, given the objective difficulty in changing people's personal attitudes, consolidated behaviours, and ways of thinking connected to the technical/professional background. For instance, one of the thorniest issues, i.e., the lack of time to engage in activities not directly related to the production of revenues, as those devoted to write down the work done and the knowledge used/generated, cannot be solved if people are not aware of the importance of documentation and do not feel motivated to do so, especially when they cannot derive an immediate benefit from it. In the more advanced companies, i.e. those that have been adopting sophisticated document management systems, technology plays a fundamental role, but an even more crucial role is played by the "culture of documentation" developed over the years by the employees. All of this confirms the importance of having KM- oriented HRM practices, starting with the selection and training of new hires.

5 Conclusion and future directions

The study revealed that knowledge documentation and storage is a very widespread activity among the investigated companies, which confirms the relevance of these processes. In particular, the investigated companies are aware that poor documentation generates several problems that result in a not timely response to client requests. Regarding RQ1, the study allowed us to identify some shared challenges that concern the entire document and storage process. These include, especially how to motivate people to document their activity; how to organise the documented material; how to improve the readability of the documented knowledge; how to inform employees about newly available documents. Regarding RQ2, some useful indications on how companies face the above-mentioned challenges have been collected. It is worth noting that even in the case of recurring problems, the adopted solutions are context-specific, indicating that there is no one best way of approaching the same challenge.

5.1 Limitations and research opportunities

The study is affected by the usual limitations of a case study methodology, and especially the difficult generalisation of the results. This paves the way for future research devoted to confirm what emerged from the present analysis, for example, by means of surveys. In addition, future research should investigate whether different kinds of KIBS companies (e.g. Professional or Technical KIBS) perceive challenges or face them differently.

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Top Management Perceptions on Using Analytics in Decision Making

Johanna Orjatsalo*

LUT University, Business School
Mukkulankatu 19,
15210 Lahti, Finland

Henri Hussinki

LUT University, Business School
Mukkulankatu 19,
15210 Lahti, Finland

Jan Stoklasa

LUT University, Business School
P.O. Box 20,
53851, Finland

* *Corresponding author*

Abstract

Firms use business analytics to improve their decision making. Analytics applications are increasingly used for decision automation regarding routine processes, and business analytics models and tools have been created for supporting firms in future planning and prediction. While benefits of using analytics to monitor, develop and improve daily operations have been reported by many scholars, the role of business analytics in improving non-routine decisions has remained somewhat uncharted. Top manager role often requires making non-routine decisions. Using thematic analysis of 12 interviews conducted in large Finnish firms, this paper outlines the perceptions of top managers on using business analytics when making decisions. It contributes to the currently ongoing academic discourse on information technology business value and business analytics business value by demonstrating how firms apply business analytics in top management decision-making activities.

Keywords – strategy, strategic management, decision making, business analytics

Paper type – Academic Research Paper

1 Introduction

Knowledge is in an essential role when firms make resource-related decisions to enhance their competitiveness (Spender, 1996). Firms are continuously developing their business analytics capabilities, as they expect the increased focus on data, analysis, models, and fact-based management to improve their ability to make such decisions (Davenport and Harris 2017). Supported with analytics-based outputs, decisions may become more accurate, and may require less human involvement (Kesavan and Kushwaha, 2020). Improved business processes and decision-making performance enabled by analytics may also result in improved organizational performance (Chatterjee, Rana and Dwivedi, 2021).

Many of the decisions made by top management require making future predictions of the firm's continuously evolving environmental and strategic contexts. While firms continue to invest in business analytics (BA), it remains somewhat unclear how BAC built with these investments are facilitating top management decision making. When, how, and why top managers do or do not utilize BA when making decisions?

In this paper, we respond to these questions by outlining the role of BA in top management decisions. First, we recap what has been suggested in the previous literature on managerial decision making and the role of BA in this context. Based on 12 semi-structured interviews of top managers in large Finnish firms, we outline why top managers see using BA is important for firms. Additionally, we describe different situations where top managers use BA to support their own decision making. Finally, we discuss future research opportunities on this arena.

2 Theoretical background

2.1 Managerial decision making in organisations

Firms and their managers get involved with different types of decisions. The nature of these decisions varies from structured, programmable, routine-type decisions that typically have well-defined decision criteria and well-known consequences to complex and unstructured, problem-solving type decisions that require making assumptions as the context and consequences are novel, and adequate information required for decision making cannot be stated or gathered (Simon & Norton, 1960; Holsapple, 2008). According to March and Simon (1993)

these two decision types can be considered as opposite ends of a continuum. "Routine decisions" that are often repeated evoke reactional choice and lead to an expected decision. On the other hand, "problem-solving decisions" require a thorough understanding of the novel situation, dedicated effort to search and evaluate choice alternatives and accepting the uncertainty. Many decision situations fall between these two ends, as they include both familiar and novel aspects. (March & Simon, 1993)

Regarding firm resources, decision making responsibility often lies with managers. In large organizations, managers on higher levels of the organisation typically focus on steering the strategic-level allocation of firm resources through the decisions they make, while the managers on lower levels concentrate on operative-level decisions that aim at optimising the usage of these allocated resources (Noda & Bower, 1996). In addition to decisions related to current resource allocation, top managers are also involved in strategic decision making concerning firm longer term objectives together with resource acquisition and development required to achieve these objectives (Noda & Bower, 1996; Eisenhardt, 1999).

Labelling an individual decision as "strategic" or "operative" is not often obvious, as the nature of the decision made depends on how it is viewed. The decisions made on different levels of the organisation concerning firm resources are strongly interlinked; new resource acquisition and development shapes the role and allocation of already existing resources, and the decisions made on lower levels of the organisation regarding the latter may impact top management ability to seize new strategic opportunities (Noda & Bower, 1996).

Top manager role often involves participating in management team decision making on firm or business unit level (Hambrick & Mason, 1984). As management team members, they make decisions on firm- or unit-level resource acquisition and allocation, while they also represent their own unit or function that needs to receive an allocation of these resources (Edmondson, Roberto & Watkins, 2003).

2.2 The role of analytics in managerial decision making

BA output is often considered to have more important role in operative decision making than in strategic decision making, due to different nature of these decisions (Kunc & O'Brien, 2019). While routine decision making seems to highly benefit from using analytics-based tools and models in terms of faster and

more accurate decisions, analytics models created for supporting strategic considerations often need to be specifically tailored for solving somewhat unique problems that are highly dependent on the firm's environmental and strategic contexts (Luoma, 2016). In addition to understanding past performance and intraorganizational characteristics, strategy formation requires firms to develop understanding of their uncertain and dynamic environmental and strategic contexts (Hutzschenreuter & Kleindienst, 2006).

Analytics benefits are often considered to materialize in the form of improved decision making (Davenport & Harris, 2017). BA supports decision makers to detect patterns that indicate future events based on historical data (descriptive analytics) or helps them predict whether and when the event will happen (predictive analytics). Analytics can also be used in a prescriptive manner, to proactively suggest or even to make decisions based on predictive analytics outcomes. (Lepenioti et al., 2020). Decisions of more structured and routine nature can be automated using analytics algorithms, to the extent that human role is no longer needed (Faraj et al., 2018).

In those decisions where human role remains essential, analytics is used to amplify human intelligence (Wijnhoven, 2021). Using BA in decision making may also enhance the organisations' knowledge co-creation (Acharya et al., 2018) and help them make decisions based on knowledge (Marjanovic, 2022). However, the benefits of analytics are achieved only when decision makers possess the ability to process the information provided by analytics and utilise it when making decisions (Cao, Duan and Cadden, 2019), or to turn the insights enabled by analytics into action (Marjanovic, 2022).

Our interest with this study lies in the role of BA in top management decision making; when is it utilized, how, and why? Next, we will describe the research methodology used for discovering responses for these questions, followed by the research results.

3 Methodology

3.1 Research design

Qualitative research design often forms as an outcome of iterative process (Saldana, 2013) and this study is no exception. We commenced the process by familiarizing ourselves with previous literature on BA and top management

decisions. The literature review led us to consider potential research questions to be investigated and based on the nature of the research questions (why, when, and how, see Saldana et al, 2011) we decided qualitative interviews would be a suitable method for data gathering.

Another consideration we had to go through was to select who to interview. Our main research interest was top managers who would be involved with longer-term strategic decisions concerning their firm, and who were working in large Finnish firms (annual turnover >200 MEUR) that have significantly invested in digitalization initiatives during the past decade. To identify those firms that had shared their digitalization initiatives within media, we went through the news published within the main media. Among these firms, we then identified suitable contacts via our networks to propose participation in our research.

As we were agreeing on the interviews with the potential interviewees, research material confidentiality was brought up on several occasions. To adjust our research with firm confidentiality requirements, we guaranteed anonymity for the interviewees as well as the firms and industries they represent.

3.2 Data gathering

Regarding data gathering approach, we decided to utilize semi-structured interviews to collect the views from potential interviewees. Semi-structured interviews include mainly open-ended questions that can be derived from existing theories, and thereby enable collecting experience-based data while maintaining the connection with theoretical premises the research will be built on (Galletta, 2013). An interview guide was drafted and tested using one interview. The planned duration for an individual interview was 60 minutes.

The amount of data required to conduct qualitative research depends on research setup. To be able to build credibility and trustworthiness for interview findings, at least ten interviews are recommended (Saldana et al, 2011). We interviewed altogether 12 top managers, and the average duration of an interview was 62 minutes (see Table 1 for individual durations for each interview). Nine interviews were conducted onsite, and three interviews were made online using Microsoft Teams application. All interviews were recorded. The interviews were transcribed from the recordings by a third party service provider, after which we used NVivo software for coding and analysing the interviews. Interviews C and D were conducted in English and all other interviews were done in Finnish. Coding

was done in English, and the quotes from Finnish interviews used in this paper were translated in English.

3.3 Data analysis

Interview data analysis was conducted in three main stages suggested by Roulston (2014) and applying analysis procedures from qualitative analysis literature. First stage included first-cycle coding of the data using initial (open) coding approach (Saldana, 2013), after which the coding outcome was reviewed. During the second stage, the condensed data was reorganized under inductive, second-cycle themes emerging from initial coding (Saldana, 2013), and then reflected with previous literature described in section 2 as well as the research questions. During the third and final stage, the themes were interpreted within the research team, and this paper was written to represent the findings.

4 Results and discussion

4.1 Decision making responsibilities of the interviewees

Interviewees had three types of responsibilities: 1) Head of Business Unit – full profit and loss responsibility for a named business; 2) Head of Function – responsibility for a named business function, such as sales & marketing or product portfolio management; and 3) Head of Strategy – responsibility for group or business unit strategic planning and strategic projects. The responsibilities for interviewees in each organization (marked with identifier A-L) as well as the background statistics of each interview are listed in Table 1.

Table 1. Interviewee responsibilities and interview statistics.

Identifier	Type of responsibility	Interview type	Language	Duration (minutes)
A	Head of Business Unit	onsite	Finnish	57
B	Head of Strategy	onsite	Finnish	60
C	Head of Strategy	onsite	English	57
D	Head of Business Unit	onsite	English	77
E	Head of Business Unit	onsite	Finnish	57
F	Head of Business Unit	onsite	Finnish	68
G	Head of Function	onsite	Finnish	64
H	Head of Function	online	Finnish	48

I	Head of Business Unit	online	Finnish	57
J	Head of Function	onsite	Finnish	60
K	Head of Function	onsite	Finnish	56
L	Head of Strategy	online	Finnish	87

The interviewees either have managerial responsibilities over a business unit or function, or they are responsible for running a strategy process for the entire firm or its unit or function. Based on the interviews, top management involvement in decision making is multifaceted and depends on the organizational context, id est decision-making role of each interviewee can be viewed as unique.

The objective of this study is not to make any generalizations on top management decision making but to explore the perceptions of top managers on using analytics. From this viewpoint, we simply acknowledge these differences regarding managerial roles and accept that they impact the perceptions of the interviewees.

4.2 Top management perceptions on using BA in decision making

4.2.1 Top management perceptions on reasons behind using BA

Based on the interviews, top managers consider several reasons for using BA in decision making. Possibilities to use BA are increasing through digitalization of business processes, but use of analytics also needs to be proactively increased to maintain firm competitiveness, to facilitate holistic business monitoring and management, to justify decisions, to make decisions based on facts, to identify new perspectives and insights, and to provide a feeling of having made the right decision. Observed reasons behind using analytics are summarized in Table 2.

Table 2. Top management perceptions on reasons behind using business analytics.

First-order categories	**Second-order themes**
Industry is digitalizing Customers are moving to digital channels	Digitalizing business processes
Competition is already benefitting from analytics Competition can be beat with analytics	Maintaining firm competitiveness
Systematic view and follow-up of firm activities Better understanding on what should be done	Facilitating holistic business monitoring and management
Backing up decisions with data Justifying why something needs to be done	Justifying decisions
Analytics enables more accurate predictions	Making decisions based on facts

Analytics-based data enables better decisions	
More data means more insights New viewpoints through analytics	Identifying new perspectives and insights
Manager prefers to use numbers Data brings comfort and peace of mind	Getting a feeling of having made right decisions

Digitalizing business processes. Based on the interviews, digitalization has been fast and moving into digital business processes has directly increased opportunities to use analytics. For some service firms, the industry operations have already previously been based on intangible assets, and digitalization has directly impacted on analytics possibilities. Interviewee F describes such situation:

> *Business analytics is a challenging concept in this <service industry> context, as everything is pure analytics. Our whole operations are about data, intangible assets. Now we do not have any paper prints anymore, everything is digital, immaterial services and solutions. Of course, some of this realizes concretely in a form of service and customer care models or through our business partners.*

Some interviewees also bring up the change in customer behaviour as one of the main reasons for digitalization and see this as an important driver also for increasing the use of BA. According to Interviewee L:

> *Customers can contact us via phone, we have good response times and all, but people have moved more and more towards digital self-services. We are not at our strongest there and decided we cannot accept this.*

Maintaining firm competitiveness. Interviewees also view what competition does when they consider the need to increase BA use. Some interviewees see that competition has managed to benefit from increased analytics use. Interviewee L considers competition to drive analytics use:

> *Why we need to do this <utilize analytics for pricing> is that our neighbours do this, and if they do this aggressively, we <get the worse customers> and get in trouble with our profitability.*

Regarding the development of BAC, being among the first on the market is considered to bring along competitive advantage, although some interviewees add that this would be a temporary advantage. Interviewee C discusses this kind of first-mover advantage as follows:

> *But if we were the ones managing first or best to bridge that and to really integrate that and leverage our business analytics capabilities to the point*

of, to address a problem on the business side, then that could give us a competitive edge.

Facilitating holistic business monitoring and management. BA is useful as it enables systematic view and follow-up of firm activities. For some interviewees, developing analytics has strongly facilitated business management. Interviewee J shares the following example:

> *<Analytics> works rather well, also when compared with others <firms>. We can get the picture one way or another. For example, product costs, we have worked a lot during my time to get better visibility on that. Earlier we got some surprises after we had already started the production process <regarding realized costs> but we have advanced this with 1-2 years, the timing when the product development project receives product cost calculations via our systems. We used to have this in Excel but now we can do it in our production systems, not of course to production but using ERP we can run the cost structure for all existing <products>, as well as prices and offers. We achieve better accuracy with this.*

BA is also seen as an essential part of running the business, as it provides a better understanding on what should be done if the business does not go into intended direction, or the planned activities do not bring the expected outcomes. Interviewee H states the following:

> *<Analytics is used> because we want to understand what activities and how the activities impact <on our business> and to ensure we are on the right track, and to get fast indication on those signals that tell us we are not on the right track, and we need to do something to fix this.*

Justifying decisions. Analytics is also useful when decisions need to be justified. When analytics output is used for decision making, it helps explain why the decision has been made. This can also be seen to accelerate decision making. As Interviewee B expresses this:

> *It is maybe the best support for business, when one feels like this and the analytics says yes, it confirms <it> and helps accelerate decision making.*

Using analytics output also helps justify why something needs to be done. In this role, analytics output is used to motivate action that is required to implement decisions. Interviewee I describes this kind of a situation:

> *I of course need to get the team excited and to believe in this thing. It helps when it is justified. I work with engineers, and I am an engineer <…> Someone said engineers do not have feelings, they only have reactions.*

> *<…> It needs to be somehow justified. Not precisely but in a way that one can make the team to believe in it. <…> Analytics helps <me> in this and I have noticed that doing things systematically and chopping things into suitable pieces helps get the adaptation and acceptance. When we can show that this is not in fact that bad, because <this, this and this>*

Making decisions based on facts. BA output is also described to enable making decisions based on facts. In this context, it seems to be often compared with decisions that are based on previous experience, beliefs, or opinions. Those interviewees that mention experience-based knowledge consider analytics output to either back up or challenge the previous experience, and those who discuss beliefs or opinions see that analytics role is mainly to change these. Using analytics is seen to enable more accurate predictions than relying on previous experience or even historical data. As described by Interviewee L:

> *If you do not have <analytics based predictions>, your business is random <…> your price levels are random. If your perception of <price> being right or wrong is based purely on history, and you do not analyse the future, you only guess the price with your old parameters while the world might have changed so much that these are not valid anymore.*

Using analytics output in decision making is also perceived to lead into better decisions than relying extensively on previous experience or beliefs when making decisions. Analytics is considered to reduce bias and bring neutrality and facts into decision making, as described by Interviewee K:

> *I do myself believe that data-driven firms that base their decisions on data will manage better and make higher quality business decisions. Then these are not opinion-based or biased, or based on wrong assumptions, but we rather aim at being a neutral, fact-based firm and make decisions this way.*

Identifying new perspectives and insights. Another reason for top managers to use BA is that it helps them to identify new perspectives and insights. Especially the increased amount of data and easy access to data seem to have enabled this. These enablers are also referred to by Interviewee D when they discuss the importance of having wide data and sharing it within the organization:

> *<…> data helps us to start in the right angle, and we don't start at the same perspective. Therefore, data needs to be very wide and very opened, because this is about people's development. It's not about firm development, it's about people development. We develop, when the people develop, as a firm.*

Based on the interviews, BA output also helps top managers to look at things from new viewpoints, and this may also enable more options to choose from when making decisions. Interviewee L considers analytics can be used in a creative manner to enable this:

> *I like it because it gives clear rationale, you can set the questions right for yourself on what you look for from analytics <…> At the end, what limits the use of analytics is the imagination, <to figure out> what we could investigate.*

Getting a feeling of having made right decisions. During the interviews, individual manager's personal preferences and feelings were also emerging as an important reason for using analytics. Some interviewees described themselves as number-oriented or 'engineers' and describe this as a reason for relying on analytics output in decision making. Interviewee L explains this as follows:

> *First of all, I like numbers if you have not figured that out yet <…> Because numbers do not lie, they are nice in that sense, or they can of course lie but they are unambiguous, they are not necessarily opinions but based on analysing what happens when you take a move A and how it impacts the outcome B and what is the total cost C, and you can calculate what pays off and what not.*

Data was also described to bring comfort and peace of mind, resulting in a sense of control on running the business. Or as Interviewee A described this:

> *I can go home at the end of the day and be more certain of having made the right decisions.*

There are various reasons for top managers to use BA and analytics output as part of their role. Next, we will describe various situations where top managers do this.

4.2.2 Top management perceptions on when to use business analytics

We identified four themes describing the situations when top managers would use analytics. These include: 1) Monitoring, following up and improving business and operations; 2) Conducting proactive analysis for planning purposes; 3) Long-term planning; and 4) Evaluating strategic options and making decisions. Summary of these second-order themes and related first-order coding can be found in Table 3. Next, we will describe these themes in more detail.

Table 3. Top management perceptions on when to use business analytics

First-order categories	Second-order themes
Monitoring and improving product- and asset-related operations Monitoring and improving sales and marketing impact Monitoring and improving customer service and management	Monitoring, following up and improving business and operations
Investment planning & timing Business planning Product planning Project planning	Conducting proactive analysis for planning purposes
Long-term plans Scenario simulations	Long-term planning
Investment/divestment decisions Product portfolio decisions	Evaluating strategic options and making decisions

Monitoring, following up and improving business and operations. BA appears to have an important role in monitoring the ongoing business and operations. There seem to be two reasons for this monitoring. First, top managers want to track the progress against set targets. Interviewee A gives an example of this:

> *There may be certain areas where, it is obvious, I could not live without analytics. For example, performance-based management. The understanding how our performance is formed. It would not be enough for me if someone would just say that our turnover was this, costs were these and profit was this. It is so obvious, at least for me, to have the ability to go deeper and to measure both financial and operative performance indicators.*

Second, with the help of analytics, they can identify those areas that do not perform as expected and can decide on corrective actions based on these observations, as described by Interviewee I:

> *If we think about the business and market areas, we have eight of them. On monthly basis, we monitor how they perform in order acquisition, sales, profitability. It also helps us see where we need to support more, where we need to push them more and so on. Where it pays off to do what, and you start to see how different products can be sold with different prices and profitability margins in different areas.*

What is exactly monitored with analytics seems to be strongly connected with the individual responsibility area of the interviewee. Besides business in general,

interviewees use analytics to monitor and improve, e.g., sales and marketing, customer service and management, and product and asset-related operations. Interviewee B shares their experience on supply chain analytics and planning:

> *We are probably most advanced when it comes to supply chain analytics and planning. This is probably due to it being so complicated, it requires so many experts to make a decision that understanding this with human brain is practically impossible, we need to trust on analytics to tell us what we should do.*

Conducting proactive analysis for planning purposes. Besides monitoring the ongoing business and operations and identifying areas for improvement, top managers also use BA for more proactive planning. This occurs for certain planning purpose, such as project planning, product-related planning, business planning, investment planning, or longer-term planning. Proactive analysis and planning include combining data and information from different sources. Interviewee F provides an example:

> *We combine our knowledge base on customer needs into customers and customer relationship. This information is our profound raw material, our own information from customer base, product base, transactions. <…> We then use these to model and plan <product features>.*

Long-term planning.

Top managers also see BA output as a basis for long-term planning. BA helps form an understanding of the current situation and thereby provides a starting point for longer term strategic plans. As described by Interviewee I:

> *<Business analytics is used> to define market size and to forecast the future potential. <…> If we know where the growth comes from and what this requires from us, we then decide in the business line <…> on what to do to achieve this.*

Regarding longer-term planning, top managers also mention generating different future scenarios. This kind of scenario simulation involves BA outputs but also other types of internal and external data. Examples of the latter include governmental plans as well as different trend forecasts from research institutions and other third parties. Internal discussions also involve making assumptions as part of the analysis. Interviewees mentioned making analysis on potential growth scenarios, macro-environment development scenarios and demand scenarios. Interviewee H characterizes scenario analysis as follows:

We do need to understand the growth scenario we have ahead of us, on longer term. In this case we were talking about looking forward some 10-15 years <…> I immediately understood we need to make a lot of assumptions, but we must start from somewhere to understand how the world would be and what has changed <…> If we want to calculate profitability potential, we need to anchor items that are critical for this. <…> Whenever you calculate something for the future, there are politics and development of population, urbanization <…> Quite a lot of external and already researched development paths to accompany own data.

Evaluating strategic options and making decisions. BA also has a role in evaluating strategic options and making decisions. Similarly, to scenario simulations, BA output is combined with other data and information for this purpose. For example, evaluating options to invest/divest businesses or product lines were described to be examples of strategic decisions that require other information besides analytics output. Product portfolio decision was described by Interviewee I as follows:

Product portfolio, in a sense that we know about our biggest customers and their plans. Let's say we have three optional ways to <serve them>. We take one and see whether they are going that way, and this indicates whether we should go to that direction. Then we also know the trends about how these products are used globally. Our R&D team has members who have long experience, they know how trends have developed over time. They can provide experience-based information and historical information on how technological trends have changed.

4.3 Discussion, limitations and future research ideas

Top managers see many reasons for using BA, and they use it in various situations. What seems to emerge from the interviews is the different role of BA in different decision-making situations. The regular BA output does not seem to provide enough input when top management interest moves from monitoring the ongoing business into predicting what may take place in the future or evaluating what measures the firm should take on longer term perspective. This observation is in line with the previous research (Luoma, 2016; Kunc and O'Brien, 2018) that highlights the different nature of more strategic decisions that require more tailored analysis to be addressed. However, as the technological

development continues at an accelerated pace, it may bring along new opportunities for firms to increase the use of BA also in such situations.

There are some obvious limitations in this study. It was conducted in Finland involving large firms, and the empirical material consisted of 12 top manager interviews. Hence, the narrow geographical scope, the nature of the participating firms and the small number of interviews need to be considered to avoid any generalizations made based on this study.

Despite the limitations, these research findings provide useful ideas for future research. First, the material collected for this study can still be analysed further to identify those areas where top managers feel they do not benefit from using analytics. Such analysis would help identify potential measures firms could take to increase analytics usage among their top management. Second, investigating how analytics teams are currently supporting top management and how they could still increase this support may provide fruitful insight on measures to increase the use of analytics among top management. Third, launching a wider survey to collect the measures that have already been taken by the firms to increase the use of analytics would add another possibility to gain such information. Finally, to observe how the continuously evolving analytics technologies may impact BA usage in more complex, strategic decisions in firms, a longitudinal study may be a suitable solution.

5 Conclusions

The objective of this study is to examine top management perceptions on using analytics in decision making. Based on our observations, opportunities to utilize analytics have increased as business operations have become more digital, and firms need to seize these opportunities to maintain their competitiveness. From managerial point of view, analytics facilitates holistic business monitoring and management, and helps justifying decisions and making them based on facts. On the other hand, it also enables top managers to identify new perspectives and insights. At the end, it also creates top managers a sense of having made right decisions.

While top managers use analytics in monitoring and managing the ongoing operations, analytics role in planning more strategic, future-oriented moves is to be one of the information sources and not the main source of information. Whereas top managers understand the potential of analytics in this area, they

experience that other sources of information are essential when it comes to strategic decision making.

This paper contributes to the currently ongoing academic discourse on BA business value by demonstrating how firms apply BA in top management decision-making activities. For scholars and other professionals interested in understanding the use of BA in top management decision making, this paper provides novel and current insights based on real-life experiences of top managers in large firms.

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A Knowledge Management Framework for 4D HBIM

Carla Di Biccari*

CoreLab, University of Salento
Campus Ecotekne, Via per Monteroni, Lecce

Mariangela Lazoi

CoreLab, University of Salento
Campus Ecotekne, Via per Monteroni, Lecce

Lorenzo Viva

CoreLab, University of Salento
Campus Ecotekne, Via per Monteroni, Lecce

** Corresponding author*

Abstract

Heritage-specific intervention projects, through the use of the Building Information Modeling (BIM) methodology, are being continuously implemented at the level of data computerisation and process automation, across all BIM dimensions and project stages. In particular, through the 4D HeritageBIM (HBIM) phase, it is necessary to take into account specific classes of intervention of the asset and, specifically, to consider its phases of evolution through the different historical epochs. This is of considerable interest because it allows the reconstruction of the constructive evolution of historical assets. The geometric-informative model can be simulated and computerised to identify situations of degradation and weaknesses, caused by anthropic and non-anthropic factors. In this regard, the present study proposes a Knowledge Management (KM) framework for the 4D HBIM domain, with focus on a bi-directional interoperability component and the "time" variable, which can be implemented through BuildingSMART's open-source IFC (Industry Foundation Classes) format and standard and, moreover, the tasks scheduling in an upstream structured Work Breakdown Structure (WBS), also considering the Critical Path Method for process optimisation. IFC format files were applied for 4D, through the Heritage-specific tasks and their timescales, in order to describe the HBIM entities and relations. Through the implementation of 4D HBIM, it is allowed to share the same model with AEC stakeholders, exporting prepared charts and technical diagrams, obtained in the open-source exchange format to allow interoperability of related data and metadata, between different information and technology systems. The combination of KM techniques and BIM methodology is growing and has enormous potential. Many authors have focused their research on the specific topics of knowledge organisation and structuring, using

ontologies, semantic networks and various types of data mining and machine learning algorithms. The work presented, and the related KM framework, is intended to provide new research insights specifically for 4D HBIM.

Keywords – Building Information Modeling, HBIM, BIM 4D, Knowledge Management, IFC

Paper type – Academic Research Paper

1 Introduction

Building Information Modeling (BIM) is a "a set of technologies, processes and policies enabling multiple stakeholders to collaboratively design, construct and operate (Succar & Sher, 2014) any built object (including buildings, bridges, roads, etc.)" (ISO 29481-1, 2016). BIM can be considered as an effective base to develop the necessary knowledge to operate in the Architecture Engineering and Construction sector (AEC) (Marinho et al., 2021).

A central concept of BIM is the construction of a model with multiple dimensions (nD BIM). The 4D is usually associated with construction planning, sequencing activities in space and time and the use of tools like the GANTT chart and the Critical Path Method (CPM) (Sacks et al., 2018). Construction companies traditionally rely on Enterprise Project Portfolio Management (EPPM) (Lock & Wagner, 2018) information systems which offer functionalities for CPM (critical path management), production and visualization of Gantt charts, etc. BIM 4D software tools aim at combining EPPM functionalities with the visualisation of the sequential construction of the building (BIM Handbook) (Eastman & Sacks, 2018). Even if theoretically 4D BIM should be produced automatically, there is still a need for intensive manual effort.

When it comes to 4D heritage BIM (HBIM), it is necessary to consider specific types of interventions (Guerra de Oliveira et al., 2022) and the historical evolution through different epochs (Bruno et al., 2021).

The fourth dimension (time/planning/task scheduling) of HBIM aims to provide information regarding the constructive evolution of the archaeological and historical assets. Models can be simulated and computerised in order to identify degradation and critical situations, caused by anthropogenic and non-anthropogenic factors. The process can be automated and the level of information and the structural status of the archaeological asset can be analysed through the time phases established upstream.

Combining BIM with Knowledge Management (KM) techniques is a growing research topic with great potential (Wang & Meng, 2021) (Hu et al., 2022). Many authors focused on knowledge organisation and extraction from BIM models using ontologies, semantic networks and data mining algorithms (Hu et al., 2022)

Achieving interoperability among systems through terminology and semantics is essential to make data and knowledge resources effective (NIEHS, 2018). In the BIM field, Industry Foundation Classes (IFC), a standard defined by the international body BuildingSMART, are considered an efficient instrument to enable interoperability among different information systems (Gerbino et al., 2021).

For these reasons, the present research proposes a BIM-based KM framework specific for 4D management in the HBIM context. The proposed system is then implemented as an automated link of information between HBIM models and an Engineering Project Portfolio Management System.

In order to establish the characteristics of the framework, as a first step, a literature review has been carried out on 4D BIM and HBIM and their current issues and future prospects. Secondly, available software applications for 4D BIM management and HBIM management have been analysed. This second analysis focused also on existing technologies that enable the manipulation of the open data format (IFC) in an open-source environment and, moreover, technologies that enable the exploitation of the format for collaborative work, also through web-based solutions.

Using a case study on a real heritage building and a focus group with experts in this specific field, the characteristics for knowledge definition and extraction from the HBIM model, have been exposed. A BIM model has been produced according to the results of the focus group, including time parameters and organising information in specific clusters. Finally, the framework for 4D HBIM Knowledge Management is presented.

2 State of the art

2.1 Knowledge organization in BIM: the role of IFC.

One of BIM traditional aims is solving issues and costs deriving from inefficient information interoperability in the construction sector(Eastman & Sacks, 2018), where information is created *"and managed by multiple systems and multiple*

parties through different phases of a project". the Industry Foundation Classes (IFC) are one of the instruments for interoperability available in the BIM context.

Specified and developed by BuildingSMART, IFC is an open, vendor-neutral data repository for the semantic information of building objects, including geometry,

associated properties and relationships (Thein, 2011).

ISO 16739 describes the data schema of the IFC standard using the dedicated data modelling language EXPRESS. Using IFC it is possible to create, share and update models by putting the related information into a pre-defined and widely accepted skeleton that can be read by a number of BIM software applications.

IFC, together with system integration and the use of cloud technologies, make collaborative work on a central BIM model possible (Eastman & Sacks, 2018), enabling knowledge management (Kivits & Furneaux, 2013).

IFC follow a "quasi" object-oriented approach and describes buildings information and their relationships as a set of objects with attributes (Theiler & Smarsly, 2018).

When the need to include new, special parameters into IFC arises, IFC schemas can be "extended" using particular mechanisms (Yang et al., 2021), (Hamledari et al., 2017) and (Lauro, 2017). The first is to create new *entity types* and add them to IFCs including the necessary relationships; the second method is to instantiate the IfcProxy, IfcBuildingElement entities; and the third method is to implement Property Sets. The three methods described above have a set of *pros and cons*, and they are suitable for different application needs and professional fields.

2.2 4D BIM and its challenges

The term 4D BIM refers to the nD BIM definition, in which a model of a building can goes beyond the traditional three-dimensional representation with the additional dimensions used to describe a specific aspect. The fourth dimension of BIM, 4D BIM, has been traditionally associated with the description of the evolution of construction works through time and their management. Every object included in the model contains specific information about the project phase to which it belong and when and how it will be constructed (Koutamanis, 2020). (Koutamanis, 2020) in particular, proposes an extended definition of BIM 4D as "*a sequential list of events, including all milestones in the design, construction, maintenance and usage of the symbolized object, regarding either*

changes in its form and substance or in its relations to the environment". One of the main applications of 4D concerns the scheduling of specific construction activities. Events and their nesting are used to divide construction activities into work packages, using the Work Breakdown Structure (WBS) (Park & Cai, 2017).

Moreover, 4D models allow representation, visualization and analysis of the variables affecting the construction phase and, when managed with dedicated software applications, they allow time, cost, quality and safety management (Ding et al., 2014).

Summing up, 4D models, when managed with specific software applications, should allow to:

- define, organize and visualize the project's WBS (Work Breakdown Structure, *i.e* the structured list of all project activities);
- associate each object of the model to the different activities in the WBS;
- visualize the GANTT diagram of the project and the Critical Path;
- simulate and visualize the evolution of the construction and its single components through time;
- identify and resolve possible conflicts (overlapping of incompatible processing, etc.), then enabling the *clash detection* over time;
- federate several 3D BIM models
- adding relevant activities to all objects, even those not directly related to the work (objects in a material storage area, etc.)
- share the 4D model with colleagues and professionals, exporting the diagrams and graphs obtained in different formats for enabling the interoperability.

Syncro Pro (Bentley software), Navisworks (Autodesk) seems to be the most popular 4D BIM modeling commercial software applications (Messi et al., 2022) but many others are available on the market (e.g. Bexel Manager (Bexel Consulting), Acca USBIM.gantt (Acca software), Vico Control (Vico-Software), etc.)

On the other hand, the commercial major applications for EPPM are: MS project, Oracle Primavera, SAP EPPM, whereas ProjectLibre or ProjeQtOr can be listed among the available open-source solutions.

2.2.1 Challenges for BIM 4D: organizational, standards, software

Even if the benefits for 4D BIM are commonly recognised, a full exploitation of 4D BIM is still affected by a set of organizational and technical (software

functionalities) issues (Swallow & Zulu, 2019), (Campagna-Wilson & Boton, 2020), (Doukari et al., 2022).

Organizational issues:

- The temporary and unique nature of a project team and the related need to constantly adapt the working methodology to each new project;
- Lack of skilled and qualified staff and the cost of training;
- Industry's resistance to change;
- Poor involvement of subcontractors, manufacturers and suppliers;
- Lack of shared industry standards.

Technical issues:

- Lack of a fully collaborative environment;
- Costs of new IT tools and infrastructure;
- Limited activity scheduling functionalities;
- Difficult automation of the link between 3D objects and the schedule;
- Lack of interoperability between software applications;

(Doukari et al., 2022) also highlights:

> *"the effort and skill needed to cope with the incompatibility between BIM authoring tools (e.g., Revit and ArchiCAD) and legacy scheduling tools (e.g., Primavera and MS Project) using 4D BIM management tools (e.g., Navisworks and Synchro Pro)"*

2.3 4D HBIM and its challenges

When BIM concepts are applied to cultural heritage sites and buildings, the term Heritage BIM (HBIM) is used.

Producing a HBIM model usually starts from acquiring a point cloud survey of the heritage asset and entails *"the creation of a parametric library of parts and then mapping these library parts onto the point cloud"* a strategy "*required to model the more complex shapes found in historic buildings*". HBIM includes also adding information about methods of construction, materials and surveys to the model. (Murphy et al., 2009).

Three types of 4D models can be produced for cultural heritage (Rodríguez-Gonzálvez et al., 2017): (i) a model representing the diachronic evolution of an asset no longer existing apart from some archaeological remains, (ii) the reconstruction of the diachronic evolution of a structure or environment based on

the historical analysis of data acquired on assets physically accessible at the present time or at an earlier time, (iii)a 4D BIM model related to the prediction of the diachronic evolution of an historical structure in the future based on the analysis of data acquired on physically accessible assets at different times.

In order to optimise the **knowledge organisation** related to a Heritage asset the **semantic description** of the architectural elements is crucially relevant. Semantic technologies like taxonomies, glossaries, knowledge graphs, and ontologies are needed to correctly produce HBIM models. (Guerra de Oliveira et al., 2022) (De Luca et al., 2006). Moreover, the formalization of knowledge into the model should consider the types of interventions specific to the heritage domain. (Guerra de Oliveira et al., 2022) for instance, lists the following types of heritage-specific interventions: conservation, maintenance, preservation, restoration, reconstruction, adaptation, demolition, rehabilitation, repair, renovation, additions, remodeling, refurbishment and retrofitting. For each type of intervention, distinct types of geometrical data (geometric, alphanumeric, documentary and operational data, supported by reliable representations, identification and definition of concepts, classes and relationships between each *cluster*) should be considered in order to obtain a valuable HBIM model.

Once the HBIM model has been produced, specific tools and software instruments are needed to perform 4D Data Management and Visualization on cultural Heritage (Rodríguez-Gonzálvez et al., 2017).

Organizing knowledge for heritage asset using IFC is still a challenge and the scientific research has proposed a number of solutions related to the specific project/asset. (Banfi, 2017),(Brusaporci et al., 2018), (Diara & Rinaudo, 2020).

(Bruno et al., 2021) analyse the historical evolution of Heritage BIM through the different eras. Answering to the need of a 4D for HBIM they define 4D **HBIMM** (Historic Building Information Modelling and Management) as a constantly evolving interface on which to progressively add future refurbishment and restoration interventions, allowing **interoperability** among stakeholders. It integrates the Historic Building Information Modelling (HBIM) with the **Information Management and 4D simulation** in order to achieve the above-mentioned objectives, employing the capability of BIM tools.The authors provide a framework and a case study but do not make use of IFC, still relying on a commercial proprietary platform.

In summary, the following issues for 4D HBIM were identified:

- Lack of international standards in the Heritage professional sector;

- IFC classes not yet sufficiently defined in the HBIM domain;
- Interoperability in 4D HBIM which needs different platforms and databases to be linked together;
- Need to implement tools to automate processes for 4D HBIM, especially into the *open-source sphere*.

Among the main issues, mentioned above, which serve as a concrete obstacle to be able to make the fourth dimension of Heritage (4D HBIM) possible, the most important and in need of development in the coming years is certainly the one related to the lack of interoperability of IT systems and different proprietary software platforms.

3 Defining the Framework

The present study proposes a new framework for scheduling, Management and Interoperability of 4D HBIM (Fig.1, below).

The framework is based on the bi-directional interoperability of two *logical levels* implemented through two different software environments: the BIM authoring tool and a BIM-based EPPM.

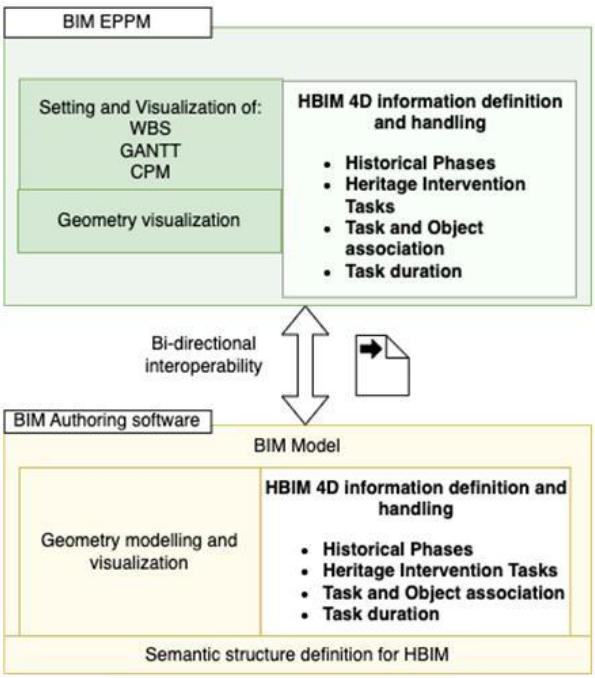

Figure 2 - KM Framework for 4D HBIM (Pt.I), two logical levels and software environments

First, the semantic structure of the HBIM asset is defined and agreed among the stakeholders, and described using the IFC classes in the specific field of Heritage, defining in advance which specific structural components of the heritage asset were going to be structured in the BIM Authoring software by predisposing the model to interoperability through the structuring of the IFC classes, also considering the different historical epochs.

In the current study, specifically, IFCs were used:

- to represent 4D (tasks and their duration)
- to describe specific entities for HBIM

The BIM Authoring software allows the generation of a high level of information in the Heritage domain (HBIM), through the asset geometric modelling and, simultaneously, its visualisation, enabling the preparation of the related Heritage intervention activities through the different historical epochs. In addition, the duration of each specific activity is also linked. In the proposed framework, the bi-directional interoperability of the proposed levels has a crucial role. From the software environment of BIM Authoring, it is possible to switch to the one of BIM EPPM (Enterprise Project Portfolio Management), in the distinctive of HBIM 4D, where, in addition to the geometric implementation and visualisation, the WBS (Work Breakdown Structure), the GANTT of the project tasks, their scheduling and the related CPM (Critical Path Method) planning, are associated.

The BIM-based EPPM level is based on two software environments where bi-directional interoperability was applied through the IFC model and classes definition, between Blender *open-source* software concerning the BIM modeling phase, and the API-extended OraclePrimavera relating to the setting and visualization of the WBS, GANTT and CPM. The sharing of information *layers* and the HBIM Model on servers and BIMviewer were involved. In reference to this, the IFC-specific extension enabled interoperability, the structuring, the scheduling visualization and, in conclusion, the phase of HBIM 4D.

In Fig.2, below, a reference image of the Paestum Temple model, created using Blender software, is included in the proposed operational framework.

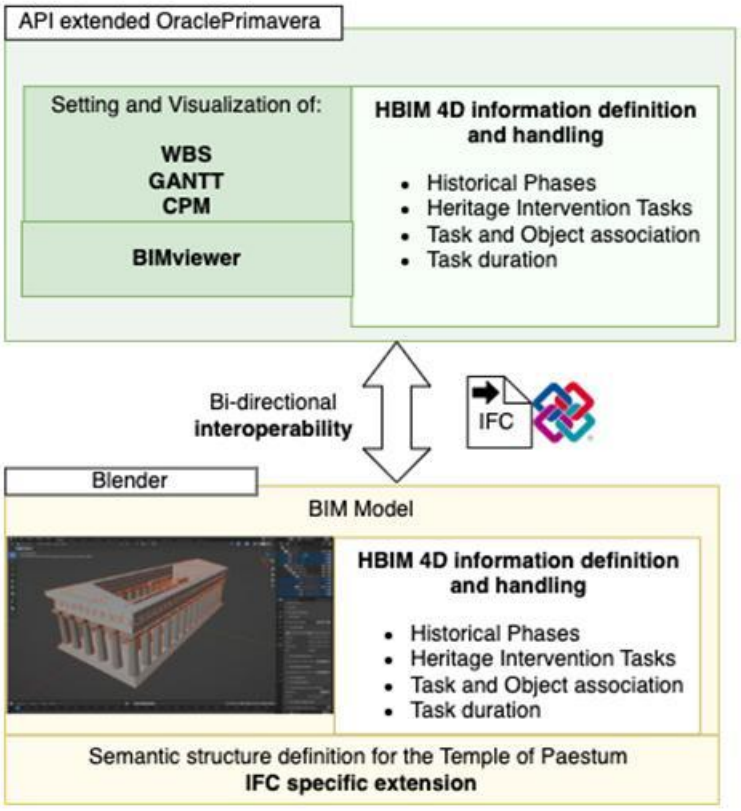

Figure 3 - KM Framework for 4D HBIM (Pt.II), open-source software and platform environments, IFC specific extension

The web-based visualization component for daily, database-supported 4D (Park et al., 2017) was considered as one of the key elements in the present work. The proposed method, taking a hint from the one of the authors (Park et al., 2017) was structured starting from the creation of the BIM model and the structuring of the tasks scheduling related to the same model, creation of the 4D HBIM model with database and automation through software platforms, database updating and scheduling, opening on web Browser/Server and importing on open-source platform for model management and visualization. These steps and specific framework, will be illustrated and explained in detail later in the current research paper. Moreover, the concept of interoperability analysis related to BIM platforms, has a distinct focus on construction management (De Gaetani et al., 2020), relating to the fourth dimension of BIM and, specifically, HBIM.

BIMserver/BIMviewer web application *tools and features* were used to implement the following features (Logothetis et al., 2018):

- 3D visualization and implementation;
- Online drawing, editing and file sharing;
- Clash Detection
- Folder hierarchy
- Support IFC files and implementation of IFC Classes
- Obj and WBS Viewer
- Enhancing BIMserver/BIMviewer tools, IFC Entities and IFC Relations
- Open-Source tools and plugins, enhanced interoperability.

3.1 Framework implementation: the Nettuno Temple, Paestum - Italy

The framework has been implemented in a real case study (Fig.3).

The semantic of a temple has been defined in accordance to (Scianna et al., 2018), as a diagram relate to the structure of the doric temple (Temple of Neptune at Paestum), with the related substructures, compositional, historical and structural elements.

The new IFC classes needed, according to the semantic (*i.e., IfcColumn*, *IfcCapitol*, *IfcAbacus, IfcEchino*) have been added to the IFC schema as new entities.

The HBIM-IFC model of the Temple of Neptune at Paestum was produced using an *open-source* software (BLENDER) and a web app based on open-source software (BIMserver/BIMviewer) for the management and visualization of the classes and features of the presented model. An Add-on to the authoring software (Blender BIM plugin) was used for the implementation and the editing of the HBIM Model of the Temple.

The open-source BIMserver platform, suitable for the purposes of this study, was used for online visualization, data management and IFC classes of the Temple Model for 4D as well, through a Simplified Architecture Diagram (Beetz et al., 2010).

Using the BIMviewer application the following results were obtained: performing queries on the model, viewing IFC classes and the overall 3D geometrical HBIM model, 4D and tasks scheduling, the "tree diagram" of the project, and the ability to perform an online check of IFC Entities and IFC Relations.

In the following figure, Fig.3, an example of a Query performed on the self-produced IFC HBIM model is reported: a query on the classes "IfcBeam" and "IfcSlab" of the Temple of Neptune in Paestum using BIMserver/BIMviewer.

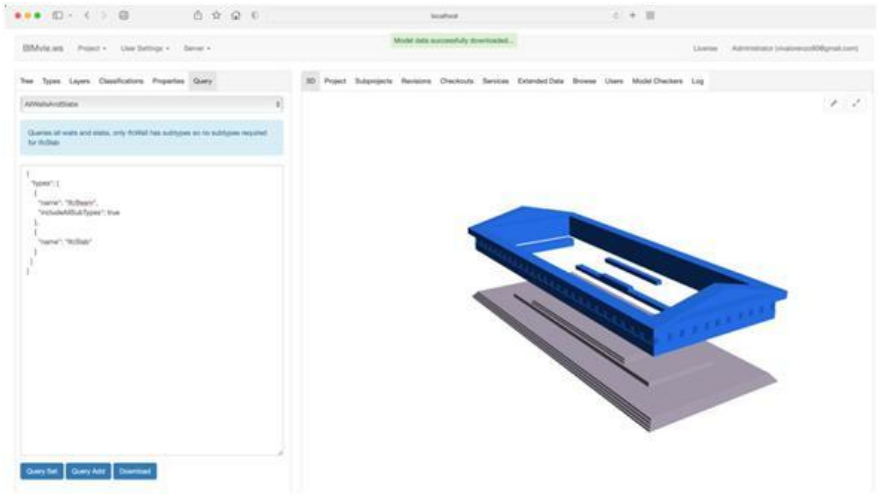

Figure 4 - Query performed on the IFC HBIM model: Paestum Temple

Once produced the model in Blender, it has been exported in IFC standard format and uploaded in the EPPM environment, extended through the API.

With the following case study, the methodological workflow of the structuring and implementation of the HBIM model linked to the fourth dimension of BIM, 4D HBIM, is reported for illustrative and project practical purposes. Four project activities were created and linked, depicted in different colors, identified as a timeline and, at the workflow level, structured as IFC classes, also by the realization of a diagram in EXPRESS language.

Within the workflow and diagram, the tasks and the time schedule, depicted in the next figure (Fig.4), were linked to the Temple Model.

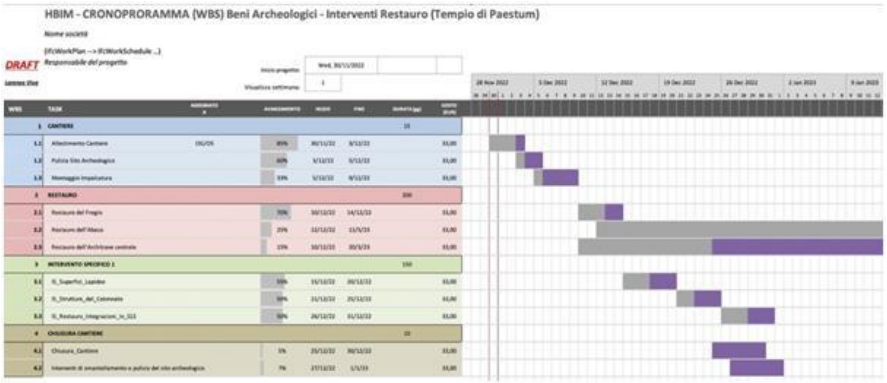

Figure 5 - Timeline/Scheduling - Project tasks, Temple restoration work - as draft. Tasks linked to IFC model and classes - Data Interoperability, 4D HBIM.

4 Conclusions

This study proposes a framework for HBIM - 4D management, using mainly open-source software. The framework was implemented using a real asset, namely, the Magna Grecian temple in Paestum. The implementation needed the definition of specific IFC classes for the HBIM, especially for describing archaeological assets, not included in the official release, resulting in increased data interoperability and information definition. The IFC Model was implemented directly on Blender as an open-source software using a plugin, with which it is possible to edit the features of the model itself, increasing the information level of the IFC classes through the upstream setting of the ObjectType/UserDefined (that can also be adopted on Autodesk Revit SW). 4D functionalities could be performed on the model using EPPM Primavera software's API. Further steps on this research are to be conducted including the design and submission of questionnaire to a sample of experts in this particular field in order to receive feedbacks and validate the framework.

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Marketing-Specific Intellectual Capital, Marketing Capabilities, and Performance: An Empirical Study

Carmela Peñalba-Aguirrezabalaga

Deusto Business School
University of Deusto
Camino de Mundaiz 50, 20012 San Sebastián (Spain)

Josune Sáenz*

Deusto Business School
University of Deusto
Camino de Mundaiz 50, 20012 San Sebastián (Spain)

Giovanni Schiuma

Dipartimento di Management, Finanza e Tecnologia
Università LUM Giuseppe Degennaro
S.S. 100 Km 18 – 70010 Casamassima, Bari (Italy)

* *Corresponding author*

Abstract

Following recent research calls that highlight the need for a more contextual approach to the study of intellectual capital (IC) that could provide managers with more fine-grained and actionable insights and recommendations, and considering recent concerns regarding the contribution of the marketing function to firm performance in the age of data, this paper aims at analysing how investments in marketing-specific structural capital and relational capital contribute to enhance marketers' knowledge (i.e., marketing-specific human capital) and lead to superior organizational marketing capabilities (i.e., product, price, place, and promotion) that translate into superior market performance and, ultimately, competitive advantage (i.e., superior financial performance). Based on survey data from 346 Spanish firms over 100 employees and using structural equation modelling (SEM) based on partial least squares (PLS), we find that both marketing-specific structural and relational capital are positively and strongly related to marketers' knowledge and that all marketing-specific IC categories (human, structural, and relational) are positively and significantly associated to marketing capabilities. At the same time, capabilities are strongly and positively related to market and financial performance. While marketing-specific structural capital is related to financial performance only indirectly (i.e., via human capital,

marketing capabilities, and market performance), human and relational capital are both directly and indirectly related to financial performance. Our findings also reveal what specific knowledge resources within each IC component are the most relevant, thus offering specific guidelines to improve marketing-related resource allocation decisions.

Keywords – Intellectual capital, Marketing, Marketing capabilities, Market performance, Financial performance

Paper type – Academic Research Paper

1 Introduction

Today's data analytics and digital revolution has completely transformed the marketing function (Sha and Murthi, 2021). The process by which companies engage customers, build strong customer relationships, and create customer value to capture value from customers in return (i.e., marketing; Kotler and Armstrong, 2018) is increasingly a data-driven process. Consistently with the above, marketing is the organizational unit where most data analytics efforts are being applied (McKinsey, 2020; The CMO Survey, 2022). However, the impact of the marketing function in the bottom line remains and open question. A recent survey found that 73% of CEOs think that marketers lack credibility and have quite a bit of work to do to earn their trust (Brenner, 2020). Indeed, since the early twenty-first century, a crisis of confidence set in (Webster et al., 2005) and a perceived lack of marketing accountability undermined marketing's credibility (Sha and Murthi, 2021). Voices emerged claiming that if marketing wanted "a seat at the table" in important business decisions, it had to link to financial performance (Lehman, 2004). This gave rise to a series of empirical studies analysing the relationship between marketing capabilities and firm financial performance— see Kamboj and Rahman (2015) for a summary—and between different types of marketing outcomes (e.g., customer satisfaction, customer value, brand awareness, etc.) and different facets of financial performance (e.g., firm value and/or stock performance; Sha and Murthi, 2021).

Despite the increasingly data-driven nature of the marketing function, these studies seldom include marketing-specific knowledge resources as a key foundation of marketing capabilities leading to superior market and financial performance. At best, market orientation is included as a complementary asset that works in conjunction with marketing capabilities (e.g., Morgan et al., 2009).

Such market orientation is conceived as "the extent to which the firm engages in the generation, dissemination, and response to market intelligence pertaining to current or future customer needs, competitor strategies and actions, channel requirements and abilities, and the broader business environment" (Morgan et al., 2009, p. 910). Thus, market orientation is a behavioural concept and the deployment of the kind of behaviour it implies should lead to the acquisition of knowledge resources (i.e., knowledge about customers, competitors, channels, and the broader business environment) that are disseminated throughout the organization to produce superior customer value (Kumar et al., 2011).

However, focusing on behaviour and omitting marketing-specific knowledge resources (i.e., marketing-specific intellectual capital—IC; Peñalba-Aguirrezabalaga et al., 2020) prevents to identify what kind of knowledge investments need to be prioritized to improve firm marketing capabilities (i.e., product, price, place, and promotion; Morgan et al., 2009; Kotler and Armstrong, 2018), increase the chances of customer attraction, retention, and cross-selling (i.e., market performance; Kotler and Armstrong, 2018) and improve financial performance.

People working at the marketing unit (i.e., marketing-specific human capital) are the ultimate decision-makers regarding marketing mix components. Therefore, hiring employees with proficient marketing knowledge and skills should translate into more effective marketing mix decisions. Nevertheless, other types of knowledge investments by the firm could contribute to enhance marketers' knowledge and improve the quality of these decisions. According to the IC literature (Reed et al., 2006), such knowledge investments may refer to knowledge generated through and embedded in personal relationships (in this case, relationships with other people in the marketing unit, with people from other functions within the company, with customers, and with other external actors; Peñalba-Aguirrezabalaga et al., 2020) and to knowledge generated by means of information and communication technologies and/or residing in the organization's information systems, databases, documents, routines, and/or procedures (i.e., marketing-specific structural capital; Peñalba-Aguirrezabalaga et al., 2020).

The first type of knowledge investment (i.e., investment in relational or social capital) implies a personalization knowledge management strategy (i.e., a person-to-person approach in which networks of relationships are the principal instrument for transferring tacit knowledge), while the second type of investment

(i.e., investment in structural capital) involves a codification knowledge management strategy or people-to-documents approach grounded on explicit knowledge (Hansen et al., 1999; Buenechea-Elberdin et al., 2018).

Considering the above and based on the resource-based view of the firm, this paper aims to bridge the gap between the marketing function and financial performance by showing how investments in marketing-specific structural capital and relational capital contribute to enhance marketers' knowledge (i.e., marketing-specific human capital) and lead to superior organizational marketing capabilities (i.e., product, price, place, and promotion) that translate into superior market performance and, ultimately, superior financial performance. By analysing direct and indirect relationships in the knowledge resources -> marketing capabilities -> market performance, and ->financial performance chain, this paper will offer a fine-grained picture of how the marketing unit contributes to firm competitive advantage, thus helping to restore the legitimacy and credibility of the marketing function.

2 Theoretical background

According to the resource-based view, differences in firm performance are due to resource heterogeneity (Barney, 1991; Peteraf, 1993). Firms with valuable, rare, difficult-to-imitate, and non-substitutive resources (i.e., VRIN framework; Barney, 1991) are more prone to generate sustainable competitive advantages. Among the array of resources a company may have access to, knowledge resources play a prominent role. First, organizational knowledge is a complex resource (i.e., it is often made up of different interdependent components that may be held by different individuals and units; Kim and Anand, 2018); second, it can be the result of unique socio-historical conditions and accumulated set of experiences (Barney, 1991); and third, its usability and effectiveness may be highly dependent on the characteristics of the context (i.e., something that works in a particular setting may not work in another one; e.g., Kianto et al., 2020). As a result, knowledge is much more difficult-to-imitate and replicate than tangible resources.

The set of knowledge resources a company manages and has access to constitutes its intellectual capital (Youndt et al., 2004; Reed et al., 2006). Within the IC literature, knowledge resources are usually classified into three main categories, depending on where they reside (e.g., Reed et al., 2006): human capital (i.e., knowledge residing in individuals); structural or organizational capital

(i.e., knowledge residing in the organization, e.g., in its information systems, databases, documents, manuals, or other kinds of knowledge repositories); and relational or social capital (i.e., knowledge generated through and embedded in personal relationships). While structural capital is mostly related to explicit knowledge (i.e., knowledge that "can be expressed in words and numbers, and easily communicated and shared in the form of hard data, scientific formulae, codified procedures, or universal principles"— Nonaka and Takeuchi, 1995, p. 8), relational capital is mainly related to tacit knowledge (i.e., subjective insights, intuitions, and hunches, which are not easily visible and expressible, and are highly personal and hard to formalize— Nonaka and Takeuchi, 1995). According to the proponents of the IC view of the firm (which constitutes a mid-range theory dealing with a specific aspect of the more general resource-based view, i.e., knowledge resources), both types of IC (structural and relational) could be used to leverage human capital and thus improve employees' knowledge (Reed et al., 2006).

Most of the time, IC research adopts an organization-wide perspective and studies seeking to analyse the relationship between IC and different types of performance focus on organization-wide human capital, structural capital, and relational capital. However, recent research calls highlight the need for a more contextual approach to IC that could provide managers with more fine-grained and actionable insights and recommendations (Kianto et al., 2020; Peñalba-Aguirrezabalaga et al., 2020) and that could allow to analyse the contribution of specific organizational units to overall firm performance (e.g., Sáenz et al., 2022). In this light, Peñalba-Aguirrezabalaga et al. (2020) coined the notion of marketing-specific IC. This refers to "all of the valuable marketing-specific knowledge resources than an organization manages in developing its marketing capabilities and achieving its marketing-related goals" (Peñalba-Aguirrezabalaga et al., 2020).

As for company-wide IC, marketing-specific IC is split up into three main categories: marketing-specific human capital (which includes marketers' customer, product/service, and market knowledge, as well as employees' marketing-related skills), marketing-specific structural capital (which encompasses knowledge generated by means of marketing-related IT solutions as well as marketing department's "organizational memory"—i.e., other knowledge residing in the organization that does not necessarily imply data processing), and marketing-specific relational capital (which includes knowledge generated

through and embedded in the marketing department's internal and external relationships) (Peñalba-Aguirrezabalaga et al., 2020).

The above definition of marketing-specific IC highlights the role of knowledge resources as the building blocks of organizational capabilities (in this case, marketing capabilities). According to the resource-based literature, resources must work together to carry out key activities and achieve desired end results (Grant, 2021). More precisely, organizational capabilities are "complex bundles of skills and accumulated knowledge, exercised through organizational processes, that enable firms to coordinate activities and make use of their assets" (Day, 1994, p. 38). In line with the above, marketing capabilities are exercised through marketing mix processes (Morgan et al., 2009), namely, product management and development, price setting, distribution channel management—i.e., "place"—, and communication or promotion activities. By means of the right mix of the above elements, companies expect to attract and retain customers, as well as to increase their sales to them, which constitutes a firm's market performance (Kotler and Armstrong, 2018). However, to translate into positive financial performance, sales-related outcomes derived from marketing capabilities should be combined with efficient use of resources and the selection of most profitable alternatives.

3 Hypothesis development

3.1 The reinforcing role of marketing-specific structural and relational capital vis-à-vis marketing-specific human capital

Marketing department's organizational memory (i.e., any stored marketing-related knowledge that employees can access physically and/or digitally; Peñalba-Aguirrezabalaga et al., 2020) provides marketers with a useful source to improve their customer knowledge, product/service knowledge, and market knowledge, as well as to improve their marketing-related skills. In other words, organizational memory (i.e., one of the two constituents of marketing-specific structural capital) offers employees the opportunity to leverage on past experience (Walsh and Ungson, 1991). For instance, having access to customer historical data may help discover useful insights regarding customer preferences, needs, and behaviour. Likewise, documented knowledge on product development, specifications, and performance may help marketers to better understand product features, functionalities, benefits, and limitations. Similarly, stored knowledge on market

trends and competitor analysis may improve marketing employees' market knowledge. And having access to documented best practices, case studies, and success stories may provide marketers with useful insights to improve their skills.

Moreover, today's available marketing-related IT solutions (e.g., customer relationship management systems) and data analytics tools and techniques (e.g., transactional data analytics, website analytics, and social media analytics) could help improve marketers' customer knowledge by creating detailed customer profiles and identifying behavioural patterns and trends. Product analytics can also help identify what product characteristics are more appealing to customers, while competitive intelligence tools may help identify competitors' strategies and market shifts.

Therefore, the following hypothesis is formulated:

> *H1: Marketing-specific structural capital is positively related to marketing-specific human capital.*

The IC literature considers knowledge generated through and embedded in personal relationships (i.e., relational or social capital) another relevant antecedent of human capital (e.g., Reed et al., 2006). Indeed, social interaction supports the assimilation of knowledge resources by allowing the exchange and combination of each other's knowledge to generate new knowledge (Tsai and Ghoshal, 1998; Peñalba et al., 2022). For instance, conversation among members of the marketing department on customer feedback and behaviour may favour the generation of new insights regarding customer needs and expectations, as well as on product use. Likewise, regular interaction with colleagues in the marketing department can provide opportunities for mutual learning and skill improvement. Furthermore, social interaction with people from other departments of the company, such as engineering and product development, can help marketers better understand the characteristics of the products and services they are marketing; and interaction with people from corporate development may help them better understand market trends and emerging opportunities and threats.

Moving now to external relational capital, listening directly to customers and interacting with them may lead to additional insights in terms of customer needs, preferences, reactions, product use, and competitor perception that registered transactions and written documents cannot capture. Moreover, interacting with customers can provide marketers the opportunity to enhance different types of skills, such as communication and problem-solving. Finally, relationships with

other external actors, such as influencers, may be a relevant source to complement customer knowledge and gain relevant insights referring to products and/or services, while interaction with distributors can provide relevant knowledge regarding consumers' buying behaviour and competitors' strategies.

Hence, we hypothesize that:

> *H2: Marketing-specific relational capital is positively related to marketing-specific human capital.*

3.2 Marketing-specific human capital and marketing capabilities

Marketers are the ultimate decision-makers regarding marketing mix components. Therefore, marketers' knowledge is a key aspect to guarantee the right decisions are made and satisfy customer needs better than competitors (e.g., Rapp et al., 2006; Peñalba-Aguirrezabalaga et al., 2021).

Deep knowledge regarding customer needs and preferences can help design products that better address them; understanding current products' characteristics and performance can lead to the identification of potential innovation opportunities based on detected weaknesses; and knowing competitors' offering very well can help identify existing gaps in the market. Moreover, understanding customers' reaction to price variations, knowing products' cost structure, and competitors' pricing strategies may help choose the best price options; and knowing customers' purchasing and product reception preferences, products' technical requirements in terms of delivery, and how different distribution channels work may facilitate more effective and efficient distribution decisions. Finally, good product knowledge may help develop communication messages that highlight products' unique features and benefits, while understanding the motivational levers that induce customers to buy may help stress those aspects that emotionally connect with them, and good knowledge of competitors' communication strategies may help develop messaging that differentiates company products from those of competitors and highlights the firm's unique value proposition.

Beyond customer, product, and market knowledge, an array of skills is also needed to develop an effective marketing mix strategy: e.g., analytical skills that allow to identify patterns of customer behaviour; adaptive skills to quickly address changes in the above behavioural patterns, market trends, and competitor

actions; and communication and creative skills to develop effective messaging that resonates in the target audience.

Thus, the following hypothesis is suggested:

H3: Marketing-specific human capital is positively related to marketing capabilities.

3.3 Marketing capabilities and performance

Several studies have demonstrated the positive relationship between marketing capabilities and firm performance (e.g., Morgan et al., 2009; Ngo and O'Cass, 2012; Cacciolatti and Lee, 2016). First, developing superior products that meet or exceed customers' expectations and deliver superior customer value may attract new customers as well as increase their loyalty. Second, effective pricing strategies may boost the chances of capturing value from customers and securing revenues by accounting for differences in customer segments and situations. Third, effective distribution helps guarantee that firm's products are easily accessible to all customers, thus facilitating repeated sales. And fourth, effective communication strategies may help build brand awareness and create strong emotional connection with customers, hence facilitating customer attraction and retention. Therefore, we hypothesize that:

H4: Marketing capabilities are positively related to market performance.

Going one step further, ensuring sales by means of new customer attraction, customer retention, and increased sales to already existing customers should contribute to improving firm financial performance. Hence, the following hypothesis is formulated:

H5: Market performance is positively related to financial performance.

However, superior marketing capabilities are also expected to be directly related to firm financial performance. Indeed, good marketing mix decisions not only should lead to increased sales but should also promote resource efficiency and help optimize the cost-benefit ratio of the implemented strategies. Thus, it is hypothesized that:

H6: Marketing capabilities as positively related to financial performance.

3.4 Additional relationships

The sequential set of relationships previously described implies a series of potential indirect relationships whose significance will also be tested in the research. For instance, it is expected that marketing-specific structural capital and relational capital affect marketing capabilities via their positive influence on marketing-specific human capital; that all types of marketing-specific IC components affect market performance via their positive effect on marketing capabilities; and that all marketing-specific IC categories and marketing capabilities affect financial performance via their positive impact on market performance.

Moreover, non-sequential direct relationships are also expected: marketing-specific structural and relational capital may have additional positive effects on marketing capabilities beyond the promotion of marketers' knowledge (i.e., marketing-specific human capital); all types of marketing-specific IC may also have additional positive effects on market performance beyond the promotion of marketing capabilities; and both marketing-specific IC categories and marketing capabilities may have additional positive effects on financial performance beyond their positive impact on market performance (indeed, the last linkage has already been included in hypothesis H6). These direct relationships will also be tested so as to determine whether partially or fully mediated relationships apply.

4 Methods

4.1 Sample and data collection

Survey data from a representative sample of Spanish companies with at least 100 employees was used to test the research hypotheses. The above employee threshold was established to guarantee that companies had a well-established marketing and sales function. The Sistema de Análisis de Balances Ibéricos (System of Iberian Balance Sheet Analysis; SABI) database was used to identify companies that met the criterion (2,436). Setting out from the above finite population, the sample size needed to carry out a representative study (342 firms) was calculated, and a stratified sampling procedure was then applied to guarantee that different proportions of company types according to industry, size, and technology level were preserved as in the population. The final sample

included 346 companies that answered the provided email or phone survey. 85.26% of the respondents held a managerial role in the marketing domain, 6.65% were marketing and sales technicians or assistants, 5.20% were CEOs, 1.45% were salespeople, and the remaining 1.45% did not specify their role.

4.2 Measures

The research model under study included two independent variables (marketing-specific structural and relational capital), three mediating variables (marketing-specific human capital, marketing capabilities, and market performance), one dependent variable (financial performance), and two control variables (size, i.e., the natural logarithm of the number of employees, and customer type, i.e., business-to-business—B2B—vs. business-to-consumer—B2C). All the independent, mediating, and dependent variables were conceived as combinations of different elements that define the conceptual variable they represent and were measured by means of 7-point Likert scales.

Regarding marketing-specific IC categories, measures used corresponded to the summary indicators suggested by Peñalba-Aguirrezabalaga et al. (2020) in their marketing-specific IC scale. In the above scale, there was a detailed list of indicators for each of the sub-components making up each IC category and one summary indicator per sub-component. The authors demonstrated that the list of indicators within each sub-component converged into the summary indicator proposed in each case. Therefore, such summary indicators could be used to represent each of the sub-components and thus analyse the relevance of marketing-specific IC as a whole by means of single and handy model (otherwise, we should have as many constructs as sub-components—i.e., 10 instead of 3—plus the remaining mediating and dependent variables, and control variables). In the case of marketing-specific human capital, there is one indicator for marketers' customer knowledge, another one for product or technical knowledge, a third one for market knowledge, and a fourth one for marketing-related skills1. In the case of marketing-specific structural capital, there is one indicator for marketing department's organizational memory and a second one for IT capital (i.e., knowledge generated by means of marketing-related IT solutions), while in the

1 As compared to Peñalba-Aguirrezabalaga et al. (2020), marketing employees' educational background and experience have been omitted, as they work as antecedents of the remaining knowledge items.

case of marketing-specific relational capital, there is one indicator for marketing department's internal relational capital (i.e., knowledge generated through and embedded in relationships between employees of the marketing department), another one for interdepartmental relational capital, a third one for customer-related external relational capital, and a fourth one regarding other external actors (e.g., regulators, suppliers, researchers, competitors, etc.).

Moving now to marketing capabilities, here there is one indicator measuring the company's position vis-à-vis competitors per each of the capabilities corresponding to the classical components of the marketing mix (i.e., product, price, place, and promotion; Kotler and Armstrong, 2018). The same type of valuation (i.e., valuation vis-à-vis competitors) was asked for the three indicators related to market performance (i.e., customer attraction, customer retention, and increased sales to already existing customers) and to financial performance (productivity, efficiency, and profitability).

As previously explained, the indicators chosen define or shape the underlying variables, instead of being caused by them (i.e., the variables "emerge" from the indicators; Hair et al., 2022). Such underlying variables constitute purely conceptual abstractions or human-made artifacts and do not really exist in nature. When this is the case, a composite measurement model applies (Henseler, 2017). In composite measurement, latent variable scores are calculated by means of linear combinations of the indicators that make them up. To calculate indicators' weights in these linear combinations, two methods exist, which are called mode "A" and mode "B". In mode "A", weights are calculated by means of simple correlations, while in mode "B", they are calculated by means of multiple regression. This choice will depend on the degree of collinearity of the indicators within a particular construct. If collinearity is high, this could cause problems in the estimation of indicators' weights in mode "B" composites. Under these circumstances, researchers should consider using mode "A" (Henseler, 2017; Rigdon, 2016). As in our case no collinearity problems exist (see the measurement model evaluation section), mode "B" has been chosen, as this allows to assess the relative relevance of each indicator when it comes to maximizing the amount of variance explained of the mediating and dependent variables.

4.3 Statistical analyses

The proposed research model was analysed with SEM based on PLS using SmartPLS 3.3.5 software (Ringle et al., 2015). This choice was made due to the "emergent" nature of the variables under study. Unlike covariance-based SEM, which adopts a common factor approach, PLS-based SEM relies only on composites (Rigdon, 2016). There are two stages of PLS-based SEM: (1) assessment of the measurement model and (2) assessment of the structural model. Conducting assessments in this order ensures that the constructs' measures are valid and reliable before drawing conclusions about the relationships among constructs (Barclay et al., 1995).

5 Results

Once the quality of the measurement model was guaranteed (detailed explanations and tables have been omitted for space reasons), one-tailed 5,000 subsample BCA bootstrap was used to test the significance and strength of the proposed relationships, (Hair et al., 2022). Table 1 shows the results obtained. As can be observed, marketing-specific SC (β = 0.353) and marketing-specific RC (β = 0.410) are positively and significantly related to marketing-specific human capital. Therefore, hypotheses H1 and H2 are supported. Likewise, marketing-specific human capital is positively and significantly related to marketing capabilities (β = 0.224), and the latter are positively and strongly associated with market performance (β = 0.447). Hence, hypothesis H3 and H4 are supported. Finally, market performance (β = 0.455) and marketing capabilities (β = 0.191) are positively and significantly related to financial performance. Thus, hypothesis H5 and H6 are supported.

Regarding the remaining direct and indirect relationships in the marketing function -> financial performance chain, the following can be observed: Marketing-specific structural capital and marketing-specific relational capital are positively and significantly related to marketing capabilities, both directly and indirectly. In other words, both IC categories have additional benefits on marketing capabilities beyond their contribution to improving marketers' knowledge. Therefore, partial mediation applies (i.e., marketing-specific human capital partially mediates the relationship between marketing-specific structural capital and marketing capabilities, and between marketing-specific relational capital and marketing capabilities).

Moreover, although marketing-specific structural capital is positively and significantly related to market performance, both directly and indirectly, marketing-specific relational capital and human capital are only indirectly related to market performance. Put it differently, although in the case of marketing-specific structural capital partial mediation applies, in the case of the other two IC categories full mediation applies. Thus, marketing-specific structural capital has additional benefits on market performance beyond the promotion of marketing-specific human capital and marketing capabilities, while marketing-specific relational capital and human capital only contribute to market performance inasmuch they contribute to strengthening marketing capabilities.

Third, marketing capabilities are positively and significantly related to financial performance, both directly (as previously said) and indirectly. Therefore, partial mediation applies (i.e., market performance partially mediates the relationship between marketing capabilities and financial performance) or, in other words, marketing capabilities have additional benefits on financial performance beyond the promotion of market-related (i.e., sales-related) results.

Finally, although marketing-specific structural capital is only indirectly and positively related to financial performance (i.e., full mediation applies), marketing-specific relational and human capital are both directly and indirectly related to financial performance (i.e., partial mediation applies). Put it differently, marketing-specific structural capital only seems to affect financial performance from the "income" side, while marketing-specific relational capital and human capital seem to affect financial performance both from the "income" and "cost" sides.

In terms of total effects (i.e., direct + indirect effects), and regarding marketing-specific IC components, marketing-specific relational capital shows the largest effect both in marketing capabilities (0.376) and financial performance (0.366), followed by structural capital and human capital, which are virtually tied, their total effects on both variables (i.e., marketing capabilities and financial performance) being between 0.224 and 0.237. However, in terms of market performance, marketing-specific structural capital is the IC component that shows the largest total effect (0.316), followed by relational capital (0.282) and human capital (0.154). Finally, the total effect of marketing capabilities on financial performance is 0.408.

As far as the relative relevance of each of the elements making up Mode "B" composites is concerned (once more, detailed tables have been omitted for space reasons), indicators' weights show that both organisational memory and IT capital

are statistically relevant within marketing-specific structural capital, the same as all dimensions within marketing-specific relational capital. However, it can be observed that internal relational capital constituents show noticeably stronger weights that external relational capital components. In the case of marketing-specific human capital, marketing-related skills and customer knowledge constitute the most relevant items, followed by market knowledge. Conversely, knowledge about products and services is barely relevant. Moving now to marketing capabilities, communication capabilities appear to be the most important, followed by product-related capabilities, and pricing. Distribution capabilities, however, are not significant. Finally, all items' weights within market and financial performance are statistically relevant.

The coefficient of determination (R^2 value) of the mediating and dependent variables was also examined, which represents a measure of in-sample predictive power that also indicates explanatory power (Benítez et al., 2020; Hair et al., 2022). As can be observed in Table 1, the amount of variance explained for marketing-specific human capital reached 48%, 33.8% for marketing capabilities, 45.1% for market performance, 54.7% for financial performance.

Table 1 – Structural model evaluation

	Effects	*STDEV*	*t statist.*	*p-values*
Direct effects on marketing-specific human capital (R^2=48%)				
Marketing-specific structural capital	**0.353**	**0.061**	**5.757**	**0.000**
Marketing-specific relational capital	**0.420**	**0.064**	**6.580**	**0.000**
Direct effects on marketing capabilities (R^2=33.8%)				
Size	0.004	0.043	0.095	0.462
Customer type (B2B vs. B2C)	-0.042	0.045	0.936	0.175
Marketing-specific human capital	**0.224**	**0.077**	**2.895**	**0.002**
Marketing-specific structural capital	**0.156**	**0.067**	**2.311**	**0.010**
Marketing-specific relational capital	**0.282**	**0.063**	**4.465**	**0.000**
Direct effects on market performance (R^2=45.1%)				
Size	-0.040	0.038	1.077	0.141
Marketing-specific human capital	0.047	0.068	0.693	0.244
Marketing-specific structural capital	**0.187**	**0.063**	**2.981**	**0.001**
Marketing-specific relational capital	0.083	0.069	1.204	0.114
Marketing capabilities	**0.477**	**0.058**	**8.288**	**0.000**

Direct effects on financial performance (R^2=54.7%)				
Size	-0.046	0.037	1.242	0.107
Marketing-specific human capital	**0.121**	**0.067**	**1.788**	**0.037**
Marketing-specific structural capital	0.006	0.060	0.101	0.460
Marketing-specific relational capital	**0.114**	**0.065**	**1.751**	**0.040**
Marketing capabilities	**0.191**	**0.058**	**3.324**	**0.000**
Market performance	**0.455**	**0.060**	**7.587**	**0.000**
Indirect and total effects of marketing-specific structural capital on marketing capabilities				
Indirect effect via human capital	**0.079**	**0.032**	**2.467**	**0.007**
Total effect (direct + indirect)	**0.253**	**0.058**	**4.063**	**0.000**
Indirect and total effects of marketing-specific relational capital on marketing capabilities				
Indirect effect via human capital	**0.094**	**0.037**	**2.583**	**0.005**
Total effect (direct + indirect)	**0.376**	**0.056**	**6.737**	**0.000**
Indirect and total effects of marketing-specific intellectual capital on market performance				
Indirect effect of marketing-specific human capital via marketing capabilities	**0.107**	**0.038**	**2.794**	**0.003**
Total effect of marketing-specific human capital (direct + indirect)	**0.154**	**0.085**	**1.817**	**0.035**
Indirect effect of marketing-specific structural capital via human capital and marketing capabilities	**0.038**	**0.015**	**2.440**	**0.007**
Total effect of marketing-specific structural capital (direct + indirect)	**0.316**	**0.059**	**5.339**	**0.000**
Indirect effect of marketing-specific relational capital via human capital and marketing capabilities	**0.045**	**0.018**	**2.471**	**0.007**
Total effect of marketing-specific relational capital (direct + indirect)	**0.282**	**0.068**	**4.165**	**0.000**
Indirect and total effects of marketing-specific intellectual capital and marketing capabilities on financial performance				
Indirect effect of marketing-specific human capital via marketing capabilities (1)	**0.043**	**0.020**	**2.198**	**0.014**
Indirect effect of marketing-specific human capital via market performance (2)	0.021	0.032	0.672	0.251
Indirect effect of marketing-specific human capital via marketing capabilities and market (3) performance	**0.049**	**0.019**	**2.582**	**0.005**
Total indirect effect of marketing-specific human capital on financial performance (1+2+3)	**0.113**	**0.052**	**2.179**	**0.015**
Total effect of marketing specific human capital (direct + indirect)	**0.234**	**0.073**	**3.218**	**0.001**
Indirect effect of marketing-specific structural capital via human capital (1)	**0.043**	**0.024**	**1.760**	**0.039**

Indirect effect of marketing-specific structural capital via marketing capabilities (2)	**0.030**	**0.016**	**1.865**	**0.031**
Indirect effect of marketing-specific structural capital via market performance (3)	**0.085**	**0.030**	**2.879**	**0.002**
Indirect effect of marketing-specific structural capital via human capital and marketing capabilities (4)	**0.015**	**0.008**	**1.984**	**0.024**
Indirect effect of marketing-specific structural capital via human capital and market performance (5)	0.008	0.012	0.640	0.261
Indirect effect of marketing-specific structural capital via marketing capabilities and market performance (6)	**0.034**	**0.016**	**2.055**	**0.020**
Indirect effect of marketing-specific structural capital via human capital, marketing capabilities, and market performance (7)	**0.017**	**0.008**	**2.221**	**0.013**
Total indirect effect of marketing-specific structural capital on financial performance (1+2+3+4+5+6+7)	**0.231**	**0.041**	**5.620**	**0.000**
Total effect of marketing specific structural capital (direct + indirect)	**0.237**	**0.064**	**3.688**	**0.000**
Indirect effect of marketing-specific relational capital via human capital (1)	0.051	0.032	1.602	0.055
Indirect effect of marketing-specific relational capital via marketing capabilities (2)	**0.054**	**0.021**	**2.516**	**0.006**
Indirect effect of marketing-specific relational capital via market performance (3)	0.038	0.033	1.165	0.122
Indirect effect of marketing-specific relational capital via human capital and marketing capabilities (4)	**0.018**	**0.009**	**2.010**	**0.022**
Indirect effect of marketing-specific relational capital via human capital and market performance (5)	0.009	0.014	0.662	0.254
Indirect effect of marketing-specific relational capital via marketing capabilities and market performance (6)	**0.061**	**0.019**	**3.291**	**0.001**
Indirect effect of marketing-specific relational capital via human capital, marketing capabilities, and market performance (7)	**0.020**	**0.009**	**2.380**	**0.009**
Total indirect effect of relational capital on financial performance (1+2+3+4+5+6+7)	**0.251**	**0.048**	**5.277**	**0.000**
Total effect of marketing specific relational capital (direct + indirect)	**0.366**	**0.068**	**5.349**	**0.000**
Indirect effect of marketing capabilities via market performance	**0.217**	**0.038**	**5.768**	**0.000**
Total effect of marketing capabilities (direct + indirect)	**0.408**	**0.059**	**6.877**	**0.000**

6 Conclusions

This paper offered a step-by-step view on how investments in marketing-specific knowledge resources contribute to both market and financial performance through the development of marketing capabilities. It also showed the contribution of individual items within each marketing-specific IC category, as well as within marketing capabilities. In doing so, it contributed to both the marketing and IC literatures.

On the one hand, the results obtained highlight the complementarity of marketing-specific structural and relational capital when it comes to boosting marketers' knowledge and marketing capabilities. Even though we live in the age of data, social interaction with internal and external actors still plays a substantial role and constitutes an extremely important source of knowledge. Especially, the results obtained show how relevant is to promote social interaction within the marketing department and with other departments of the company beyond doing so with customers and other external actors. Nevertheless, company investments in marketing-specific ICT-based solutions and data analytics, as well as in other forms of organizational memory, proved to be essential drivers to enhance marketers' knowledge and develop superior marketing capabilities.

Moreover, the results obtained contributed to restore the legitimacy and relevance of the marketing department since it was proven that superior marketing-specific knowledge resources and marketing capabilities were able to explain a large portion of firms' market and financial performance.

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PCN 2.0 Diagrams: An Improved Visual Framework for Service Processes Management and Innovation

Sara Vannelli*

Department of Industrial Engineering
University of Florence
Viale Morgagni 40/44, 50134, Florence, Italy

Filippo Visintin

Department of Industrial Engineering
University of Florence
Viale Morgagni 40/44, 50134, Florence, Italy

* *Corresponding author*

Abstract

Visual frameworks can be essential tools for service process management and innovation as long as they succeed in representing certain key features. Firstly, they should make it possible to visualize all the steps that make up the processes. Second, they should enable representing customer interaction (i.e., the interaction between customers and service providers) and customer participation (i.e., customer contribution to service production and delivery). Third, they should help identify interacting stakeholders and assess their role in the value (co)creation process. Fourth, they should allow identifying non-value-added steps. Finally, they should provide information about the duration of process steps and the channels through which the service is delivered (e.g., face-to-face or telephone).

Several visual frameworks have been developed (Business Process Modeling Notation, Service Blueprinting, etc.), but Process Chain Network (PCN) Diagrams are the most comprehensive. Unfortunately, those diagrams have some limitations. First, PCN diagrams assume that a process begins when the customer expresses a need and ends when the need is satisfied. However, this choice may be inconvenient or impossible. In addition, they usually group stakeholders. This grouping is generally functional, but sometimes more detail is needed. In addition, the description of non-value-added steps could be refined. Finally, they do not provide an understanding of the duration of process steps or the channel through which the service is delivered. These limitations are significant in complex and lengthy processes such as health services.

Taking PCN diagrams as a reference, this paper proposes PCN 2.0 diagrams to overcome these limitations. We first conceptualized the elements a visual framework should include reviewing widely used ones. Then we refined our framework by representing actual service processes. Finally, we demonstrated the power of our framework through its application to the televisit service offered by one of the leading children's hospitals in Europe.

This study contributes to the existing literature by presenting an improved version of PCN diagrams. Our framework could support researchers and practitioners in service management and innovation for its completeness and clarity. Although we show an example drawn from the health sector, the framework is assumed to be generalizable.

Keywords – Service Operations Management, Process Innovation, Visual framework, Healthcare, Telemedicine

Paper type – Academic Research Paper

1 Introduction

Visual frameworks can be essential tools in service process analysis and innovation because they highlight phenomena that otherwise might be difficult to conceptualize (Sampson, 2012). To do that, they should represent the following key **features.**

First, customers always participate in service delivery by providing resources essential to the process and/or participating in the actual execution of the process (Grönroos, 2006; Sampson and Froehle, 2006). Thus, customer interaction and customer participation are two key strategic factors of any service business (Chase, 1978; Sampson, 2000; Sampson and Chase, 2022). **Customer interaction** refers to the interaction between a customer and a provider (Grönroos, 2006). Initially, researchers focused only on face-to-face interaction (Chase, 1978) but then refined the concept. For instance, Sampson (2012) describes two primary types of interaction: the direct interaction, which is person-to-person interaction, either in person or mediated by technology (e.g., a phone call), and the surrogate interaction, in which an entity interacts with a resource of another entity, such as a technology (e.g., online banking). Increasing customer interaction may enhance customization potential (Sampson *et al.*, 2015). However, too much customer interaction may reduce operating efficiencies (Sampson and Chase, 2020) and negatively affect service quality (Frei, 2006). **Customer participation** is the degree to which a customer contributes to service production and delivery by providing inputs such as effort, preference, or knowledge (Dong *et al.*, 2015). Co-production is the case of customer participation under the provider's purview (Auh *et al.*, 2007). Increasing customer participation may facilitate the alignment between the operation's capabilities and its customers' needs and preferences (Lusch and Vargo, 2006), enhance customization (Xie *et al.*, 2008), and reduce

labor costs (Bowen *et al.*, 1986). However, too much customer participation may compromise quality and depersonalize service relationships (Sampson and Chase, 2022). Over the years, the interrelationships between customer participation and customer interaction and the resulting production models have been studied extensively (Grönroos, 2011; Meuter *et al.*, 2000; Moeller, 2008; Sampson and Chase, 2022). In recent years, we have seen companies increase interaction through servitization (manufacturers shift to a service focus (Raddats *et al.*, 2019)) and increase customer participation through self-service technologies (Frei, 2006; Sampson and Chase, 2022).

Technological advances have catalyzed a proliferation of service delivery **channels** (e.g., face-to-face, phone, online, mobile), allowing many more customer touchpoints. Combining multiple channels during the customer journey can improve convenience and access to information, goods, and services, boosting customer satisfaction, loyalty, and sales (Bell *et al.*, 2018; Wallace *et al.*, 2004). However, increasing the number of service delivery channels can alter how customers engage with firms (Gallino *et al.*, 2017; Gallino and Moreno, 2014) and introduce complexities that hinder the consistency of the service they experience (Field *et al.*, 2018). Each channel implies specific participation roles and responsibilities for both sides and can differently impact the service process's overall perceptions (such as perceived value, perceived quality, trust, and satisfaction) (Field *et al.*, 2018). Therefore, visual frameworks should consider the channel through which customer interaction occurs.

In service processes, networks of stakeholders (**Service Value Networks** (SVN)) interact to provide mutual value to all the stakeholders participating (Sampson, 2015). Thus, to manage and innovate a service process, we need to identify all the participants in the network (and not just consider the client-provider dichotomy) and their roles in the process (Sampson, 2015).

A process chain is a sequence of steps with an identifiable purpose (Sampson 2015). Customers and providers participate in a process chain to receive some benefit. Customers participate to benefit from the specialized competencies of the process chain. Providers participate to receive money that they will subsequently deploy to meet needs from other process chains. **Value** for the customers exists in two ways: value potential, which is the ability to satisfy the needs of the future, and value realization, which is the actual satisfaction of needs in the present. Moreover, a process step produces value if it develops the resources that customers will later use to realize value. Suppose any step of the

process does not contribute to either value potential or value realization, and it doesn't produce value. In that case, it could be eliminated unless it is necessary for accounting or regulatory reasons (Sampson, 2001). Thus, visual frameworks should show that information.

The **duration** of steps composing processes is crucial in service process analysis and innovation (Visintin *et al.*, 2014). It could be the reason why one process configuration results better than another. For instance, we could opt for a design that reduces the time to obtain the diagnosis or the one between two follow-up visits. Moreover, the customer's time in the system could be an important indicator of service quality. Finally, knowing the duration of steps composing processes may highlight how much time we spend on non-value-added steps.

Several visual frameworks have been developed over the years (Business Process Modeling Notation, Value Stream Mapping, Supply Chain Diagrams, Service Blueprinting, Customer Journey Map, Process Chain Network (PCN) Diagrams), but **PCN Diagrams** (Sampson, 2012; Sampson *et al.*, 2015) turn out to be the most comprehensive. Indeed, they show the steps making up service processes, the stakeholders in the SVN, the nature of customer interactions, and stakeholders' roles in the process. PCN has been used to improve service systems by introducing Information and Communication Technology (Rapaccini and Porcelli, 2013), to analyze the healthcare supply chain process (Sampson *et al.*, 2015), hotel facilities (Borges *et al.*, 2011) or the library services process (Suwadi and Jenal, 2019).

Unfortunately, the current version of PCN Diagrams is not without **limitations**. First, PCN Diagrams assume that a process begins when the customer expresses a need and ends when the need is satisfied. This choice may be inconvenient (if the process of achieving need satisfaction is very long or complex) or impossible (if need satisfaction is never achieved, as in the case of chronic diseases). Furthermore, although PCN Diagrams may show all the stakeholders in the SVN, stakeholders are usually grouped in practice. This grouping is generally functional, but sometimes more details are needed. Although the customer interaction types are analyzed, the service delivery channels are not: they classify all synchronous interactions as direct interactions and all the asynchronous interactions as "surrogate" interactions without considering the channel. Moreover, they do not distinguish between the process steps where customers recognize value potential, the ones where customers realize value, the ones that

produce value, and those necessary for accounting or regulatory reasons. Finally, they do not specify the duration of the steps making up service processes. These limitations are particularly significant in complex and lengthy service processes such as healthcare services (Roshanghalb *et al.*, 2018). Thus, we aimed to identify a visual framework capable of guiding practitioners and researchers in analyzing and innovating service processes.

Taking the PCN Diagrams as a reference, this paper proposes **PCN 2.0 Diagrams** that overcome these limitations. We first adopted a conceptual-to-empirical approach and then an empirical-to-conceptual one. In the conceptual-to-empirical phase, we conceptualized the elements a visual framework should include reviewing the widely used visual framework. In the empirical-to-conceptual phase, we refined our framework by representing actual service processes. Finally, we demonstrated the power of our framework through its application to a real case: the televisit service offered by one of Europe's leading children's hospitals.

This study contributes to the existing literature by presenting an improved version of the PCN Diagrams. The changes make it possible to provide all the information needed in service management and innovation without making the framework too complex. Indeed, the new framework is intuitive and rigorous. Furthermore, although we show an example in healthcare, the framework is assumed to be generalizable.

This paper is organized as follows. Section 0 reviews prior visual frameworks, discussing the strengths and weaknesses of each. Then, we focus on PCN Diagrams depicting its limitations. Section 0 describes how we envisioned PCN 2.0 Diagrams, while Section 0 illustrates PCN 2.0 Diagrams and provides an example. Section 5 depicts how the new framework may support complex service process management and innovation. Finally, Section 0 drafts this paper's main managerial and scientific contributions, limitations, and future developments.

2 Literature Review

Several visual frameworks have been developed over the years.

Business Process Modeling Notation (BPMN) (White, 2004) organizes the steps of the process into "swim lanes" that represent who is performing the steps. Each step exists within only one swim lane. Dashed lines connecting corresponding steps in different "swim lanes" depict interactions between steps

(White *et al.*, 2008). The arrows represent a state dependency (i.e., the process depends on some resource being in a state provided by another). This visual framework does not specify the type of customer interaction, the channel through which the interaction occurs (Müller and Rogge-Solti, 2011), or even the duration of the steps. Finally, value-added steps are not highlighted (Kazemzadeh *et al.*, 2015a).

Value Stream Mapping (VSM) (Dinis-Carvalho *et al.*, 2019; Shou *et al.*, 2017) maps processes and activities that contribute to the realization of a product, starting from the supplier to the delivery of the finished product to the customer, passing through the entire production chain. This framework aims to eliminate waste and increase the efficiency of the processes that realize product value. This type of map specifies the duration of the steps, but it is provided-centered and does not represent the activities performed by the other stakeholders in the SVN. Moreover, it omits customer interaction and customer participation.

Supply Chain Diagrams (SC Diagrams) show relationships between the stakeholders in a given supply chain (Sarkis, 2012). They do not show the bidirectional flows that characterize service supply chains (resources move in both directions between the provider and the customers) (Sampson, 2000). Moreover, they assume that there is some transfer of materials from one entity to the next (the arrows describe the various paths by which goods and services can flow through a supply chain) without specifying what takes place in the interactions.

Service Blueprinting (Shostack, 1987) is a flowchart that categorizes steps according to customer actions, visible employee actions, invisible employee actions, support processes, and managerial functions (Fließ and Kleinaltenkamp, 2004). They do not analyze the network of stakeholders involved in the process (Bitner *et al.*, 2008). Patrício *et al.* (2011) tried to address the provider-centered bias by identifying the value constellation network at one phase of analysis and then subsequently and separately designing specific dyadic service encounters with enhanced Service Blueprints. Moreover, it treats customer actions as "a black box". Eichentopf *et al.* (2011) proposed to give customers their line of visibility, line of interaction, and so forth. However, these approaches seem confusing and complex and are not widely adopted. Finally, Service Blueprinting omits the customer interaction type, but the "Physical evidence" category often characterizes the channels.

Customer Journey Map (Ponsignon *et al.*, 2018) is a visual storyline of every customer engagement with the service. The aim is to put the organization directly

in the consumer's mind to understand their customer's activities, needs, and perceptions. This framework analyses client-provider interactions and the channels through which they happen in-depth, but it only considers the activities that the customers perform (customer-centered), omitting the other stakeholders. This framework intuitively shows whether the steps bring value to the customer way (using emoticons or including the happiness curve).

PCN Diagrams combine features of SC Diagrams with features of Service Blueprinting (Kazemzadeh *et al.*, 2015b; Sampson, 2012). PCN Diagrams represent processes as sequences of steps. The steps are represented by boxes and identified by verbs in PCN Diagrams. Processes are performed by entities (all the stakeholders involved in the SVN) that act on resources (physical items, knowledge, energy, and so forth). Nouns in PCN Diagrams identify resources and entities. An entity is any process participant that makes decisions about the initiation or progress of some steps of the process (Sampson, 2015). A process domain is a set of steps that are "initiated, led, performed, and, to some degree, controlled by the process entity" (Sampson, 2015, p. 187). Indeed, each process entity has a process domain. The process domain of each entity can be divided into three regions: Independent Processing (IP), Surrogate Interaction (SI), and Direct Interaction (DI). The triangle on top of the process domain represents the degree of control of the entity over the steps: it is maximum at the center (IP region) area and decreases moving toward the sides (SI, DI regions, respectively). DI occurs when an entity person interacts with another entity person (people-with-people interaction). SI, instead, occurs when an entity person acts on/with resource(s) of another entity (belongings, information). Finally, IP occurs when an entity acts only on/with its own resources. In the PCN Diagram, there are three types of blocks: Rectangles, corresponding to "active" process steps; triangles, corresponding to waits; and rhombuses, corresponding to decision moments. Rectangles can have the outer line dotted. In this case, the step within the rectangle will only happen under certain conditions. In PCN Diagrams, the arrows that link process steps represent state dependency like in BPMN Diagrams. The symbol of money identifies costs or monetary compensations for providers. The number of emoticons represents its magnitude. Emoticons of a happy face describe value realization and value potential that customers directly perceive. Emoticons of a sad face represent non-monetary costs (such as points of inconvenience or points of pain) for customers. PCN Diagrams appear to be the most appropriate for service process management and innovation (see

Table 1). Indeed, they show the steps making up service processes, the SVN entities, the nature of their interactions, and their roles in the process.

Unfortunately, PCN Diagrams have **limitations**. First, PCN Diagrams assume that a process begins when the customer expresses a need and ends when the need is satisfied. However, this choice may be inconvenient (if achieving need satisfaction is a very long or complex process) or impossible (if need satisfaction is never achieved, as in the case of chronic diseases). Additionally, although they may represent all the entities in the SVN, they usually group entities into "macro-entity" in practice. For instance, Sampson (2012) provided the example of a restaurant. The author considered the restaurant a "macro-entity", and in its process domain, there are all the steps the entities working in the restaurant (the waiters, the owner, the pizza maker, etc.) do. This grouping is usually functional, but sometimes more details would be adequate. For instance, it may be helpful to specify who does the steps to decide how many waiters to hire. Conversely, especially if there are many entities in the SVN, generating a process domain for each of them may make the PCN Diagram unclear. Furthermore, although the customer interaction types are analyzed, the channels through which they occur are not: they classify all synchronous interactions as direct interactions and all the asynchronous as "surrogate" interactions without considering the channel. This lack can reduce diagrams' clarity and prevent identifying certain peculiarities. For instance, a face-to-face visit or a televisit (visit performed remotely) are not the same processes, although they involve several steps that are similar and that happen in direct interaction (e.g., the process step of "the doctor asks the patient to describe his symptoms"). Moving on to value, they do not specify process steps that produce value and those that are necessary for accounting or regulatory reasons. Finally, they do not show the duration of the process steps. In PCN Diagrams, dashed lines suggest a loose temporal dependency, meaning a long time passes between the connected process steps. However, the time is not quantified. These limitations are fundamental in complex and lengthy service processes such as health services.

Table 1: A comparison of the visual frameworks

Visual framework	Process steps	SVN	Duration	Customer Interaction	Channels	Customer Partecip.	Value
BPMN	X	X				X	
VSM			X				X
SC Diagram		X					
Service Blueprint	X		X		X	X	
Customer Journey Map	X		X	X	X	X	X
PCN Diagram	X	X		X		X	X

3 Methodology

We adopted a conceptual-to-empirical approach and then an empirical-to-conceptual one.

In the **conceptual-to-empirical phase**, we first conceptualized the elements visual frameworks should include reviewing the previously defined visual frameworks. Then, we drafted PCN 2.0 Diagrams and organized a **meeting with two SOM experts** to validate our proposal and collect suggestions for improvement. Finally, at the end of this phase, we updated our draft based on the recommendations.

In the **empirical-to-conceptual** phase, we refined our visual framework by representing actual service processes and inquiring about what we would need. Thus, we were able to refine part of the elements of the visual framework from empirical data.

We demonstrated the power of our framework through its application to a **real case**: the televisit service offered by one of Europe's leading children's hospitals. Then, we verified the intuitiveness and rigor of our framework by presenting the televisit process represented through it to the healthcare manager responsible for redesigning the televisit service in the children's hospital. Moreover, in this meeting, we verified the truthfulness of the process we represented. Then, we held eight meetings with doctors working in the children's hospital and one session with a minor patient caregiver to evaluate the main issues of the current

televisit process. That way, we were able to identify opportunities for improvement. We performed that analysis in July 2022.

4 Results

This section illustrates the PCN 2.0 Diagrams and an example of how they can be used. The example concerns the televisit service in one of Europe's leading children's hospitals.

4.1 PCN 2.0 Diagrams

This paragraph describes the changes introduced within the PCN 2.0 Diagrams. Table 2 summarizes those changes, while Table 3 explains the meaning of the symbols used in PCN 2.0 Diagrams.

Process Steps. We suggest using the same Business Process Modelling Notation 2.0 (BPMN) formalism to report the initial and final events. The initial event starts the process's flow without incoming sequence flow. The final event ends the flow of the process and, thus, will not have any outgoing sequence flows. We propose to represent the initial event as a circle with a fine thickness and the final event as a circle with a large thickness. That way, they can be whatever type of events, not necessarily the need recognition and satisfaction. Moreover, since it could be interesting to visualize some parts of long processes with a high level of detail while leaving the others more unrefined, we suggest grouping activities. A rectangle with a grey background could be used to group a series of related activities without specifying all the process steps composing it. Moreover, a dotted rectangle could group steps inside process phases.

Service Value Network (SVN). To achieve a compromise between process map readability and completeness, we suggest using the "macro-entities" and specifying the acting entity by reporting the abbreviated name in brackets.

Channels. Specifying all the channels seemed inadequate because it could dramatically reduce the readability of the diagrams. Therefore, we suggest specifying only whether the process steps in the direct interaction area are conducted face-to-face or remotely. Letter R inside a circle may indicate remote synchronous interactions, while letter P inside a circle may indicate face-to-face interactions.

Value. PCN 2.0 Diagrams specify the steps where customers realize value and those where customers recognize value potential as in PCN Diagrams. The symbol

of a leaf may identify the steps that produce value, and the symbol of a brick may identify the steps necessary for accounting or regulatory reasons.

Duration process steps. We suggest introducing the duration of the most important and/or inconvenient process steps for stakeholders.

Table 2: Main differences between PCN Diagrams and PCN 2.0 Diagrams

Features	PCN Diagrams	PCN 2.0 Diagrams
Process Steps	They show all the steps making up processes. A process begins when the customer expresses a need and ends when the need is satisfied.	The initial and final steps can be whatever type of steps. A circle with a fine thickness may represent the initial event. A circle with a large thickness may represent the final event. A rectangle with a grey background could identify a group of related steps without specifying them. A dotted rectangle could be used to group steps inside the process phases.
SVN	They usually introduce "macro-entities"	They use the "macro-entities" and specify the acting entity by reporting the abbreviated name in brackets.
Channels	They do not specify the duration of the process steps	They specify if a direct interaction is carried out face-to-face or remotely.
Value	The symbol of money identifies costs and monetary compensations for providers. Emoticons of a happy face identify value realization and value potential that customers perceive. Emoticons of a sad face represent non-monetary costs (such as points of inconvenience or points of pain).	They specify the steps where customers realize value and those where customers recognize value potential as in the PCN Diagrams. The symbol of a leaf may identify steps that produce value. The symbol of a brick may identify steps necessary for accounting or regulatory reasons.
Duration	They do not specify the duration of the steps	They specify the duration of the most important and/or most inconvenient steps.

Table 3: Legend

Symbol	Meaning
	Start event
	End event
	Emoticons of a happy face describe value realization and value potential that customers directly perceive.
	Emoticons of a sad face represent non-monetary costs (such as points of inconvenience or points of pain) for customers.
	The symbol of a brick identifies steps necessary for accounting or regulatory reasons.
	The symbol of a leaf identifies steps that produce value.
-$	The symbol identifies costs for providers.
+$	The symbol identifies money compensations for providers.
	The direct interaction happens in a face-to-face mode
	The direct interaction happens remotely
(N)	A nurse oversees the process step
(D)	A doctor oversees the process step
	A dotted rectangle groups the steps inside the process phases.
	A rectangle with a grey background identifies a group of related steps without specifying them.

4.2 The Example – The televisit service in a children's hospital

In Italy, patients can receive televisits via videoconferencing or telephone, and televisits can only replace follow-up visits (Ministero della Salute, 2020). Therefore, before patients can receive a televisit, they must have had at least one face-to-face visit with that doctor. The children's hospital provides the

videoconferencing televisits as described below. Figure 1 shows the televisit process using our visual framework.

Doctors choose the type of visit by assessing the patient's clinical status. If they select the televisit option, doctors email patients the form for pay the televisit and a list of required medical records to provide before the televisit. Patients must send the required medical records (photographs, results of blood tests performed outside the health facility, etc.) and the receipt of payment to a dedicated e-mail address within five days of the televised visit. A nurse is assigned to check patients have sent all the required medical records. If a patient has not sent all required medical records by the deadline, a nurse will call the patient. Once the patient has sent the required medical records, the nurse emails the doctor all of them. The doctor evaluates medical records before the televisit and enters them into the hospital's internal information system. Then, just before the televisit, the doctor may re-evaluate the medical records.

At the time of televisit, the doctor and patient log in to the regional televisit videoconferencing platform with their login credentials. If the patient does not log in to the platform at the appointed time, the doctor will contact the patient by phone.

Once the patient joins the videoconference, the televisit begins.

At the end of the televisit, the doctor communicates the identified treatment and decides whether to schedule the next visit in face-to-face mode, in televisit mode, or not to schedule a visit at all. After the televisit, the doctor completes the report, makes any prescriptions for the next visit, and books the next visit through the regional portal. Then, the doctor emails the patient the televisit report, the treatment, and the booking receipt for the next visit. If the next visit is in televisit mode, the doctor also emails the form for payment.

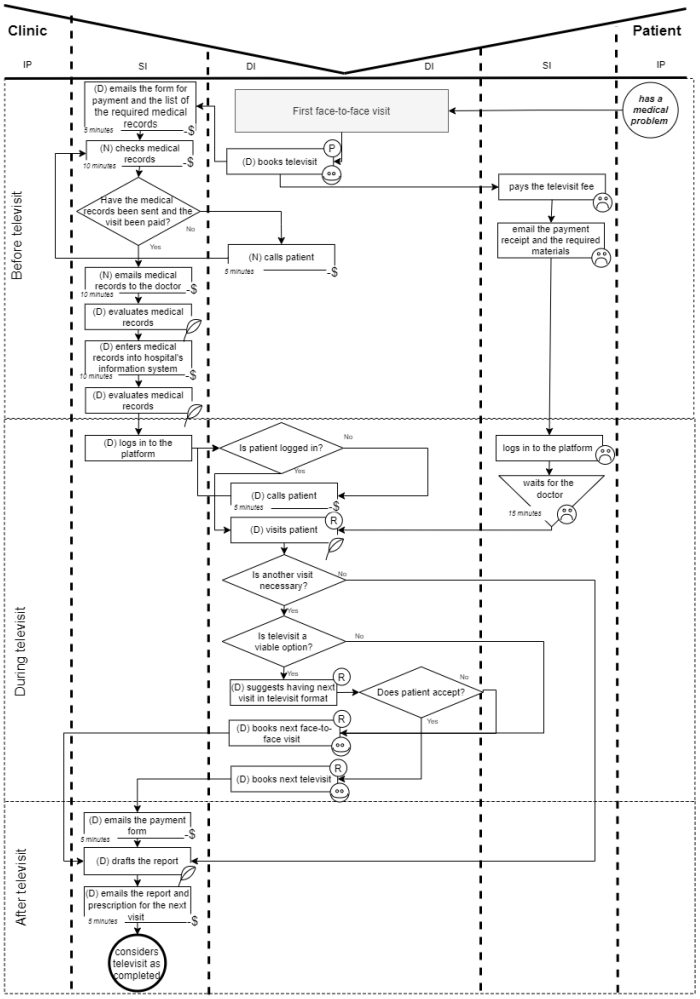

Figure 1: Televisit service in a children's hospital

5 PCN 2.0 Diagrams in systematic process innovation

This paragraph shows how the elements introduced to PCN 2.0 Diagrams might support process analysis and innovation. To do so, we focused on the case of the televisit service offered by a children's hospital.

The opportunity to select any start and end event and to group steps enables users to represent long and complex processes. For instance, in Figure 1, we specified that a televisit could only be a follow-up visit after a face-to-face one. Moreover, we separated the phases of "Before televisit", "During televisit", and "After televisit" improving the clearness of the representation.

Continuing using the "macro-entities" but specifying the acting entity by reporting the abbreviated name in brackets allows identifying if a doctor or a nurse performs the steps inside the process domain of the "Clinic" (which is the "macro-entity"). In addition, the distinction between steps carried out in televisit mode and those carried out in face-to-face one is clarified by specifying whether direct interactions are carried out face-to-face or remotely. Those changes improve the readability of the diagrams. Indeed, they have proven to help the manager, the eight doctors, and the caregiver we interviewed to understand the representation of the televisit process.

PCN Diagrams already allow for improving processes through changes in the position of steps (Sampson, 2015). Indeed, they represent enabling innovations (innovations that allow customers to do steps previously provided by others) and relieving innovations (innovations that correspond to a firm that starts doing steps previously customers did). The introduction of the duration of the steps and the refinements on value representation introduced in PCN 2.0 Diagrams enhance the potential of those diagrams to support service process improvement and innovation.

From the patients' perspective, the interviewed caregiver complained about the time patients wait on the platform. In face-to-face visits, patients wait at the clinic, thus, they can spend that time socializing with other patients, and they can ask the nursing staff the reasons for that wait. During televisits, patients find themselves waiting on their own, thus, the wait seems longer, and it can increase anxiety. Therefore, the regional platform may specify the reasons for the delay or may entertain patients (children in this case). Moreover, the interviewed caregiver complained about the platform login procedure. Therefore, the easefulness of use of the platform may be improved.

From the medical staff's perspective, the interviewed doctors complained about several steps that they currently oversee. For instance, they email the patient the payment form and enter the medical records on the hospital's internal information system. These steps seem easy enough to be delegated. Moreover, several steps could be automatized. For instance, we can imagine that future releases of the televisit platform will automatically check if all the medical records have been uploaded and eventually contact the patient. Additionally, the platform could automatically send patients the form to pay the televisit. Therefore, specifying the duration of the most inconvenient steps helps highlight the importance of eliminating or modifying them.

6 Conclusions

This study contributes to the existing literature by presenting an improved version of the PCN Diagrams. PCN 2.0 Diagrams are more elaborated and richer than the PCN Diagrams. Therefore, the proposed visual framework can support managers in identifying and analyzing the current process and depicting and selecting process design alternatives. Moreover, PCN 2.0 Diagrams are intuitive, easy to understand, and rigorous, thus, they can be easily used and understood by practitioners. Therefore, our framework is a promising candidate for healthcare process modeling, where medical staff needs to understand and discuss the process models. Although we show an example in healthcare, this methodology is assumed to be generalizable.

Finally, the feedback on the televisit experience in the pandemic years we collected in the empirical analysis can provide insights for redesigning the televisit service. For instance, Italy plans to invest much money in upgrading and improving telemedicine services (Presidenza del Consiglio dei Ministri, 2021).

In the future, researchers can improve the PCN 2.0 Diagrams. First, we could include step duration distribution (or at least the standard deviation) since it could influence service performance. Moreover, we could investigate the possibility of having other types of state dependency between steps. PCN 2.0 Diagrams consider only the Finish-to-start relationship (a step can begin once the preceding one finishes), but different dependency types can exist: Finish to Finish (a step can finish once the preceding one finishes), Start to Start (the activities must begin contemporarily), and so forth. Finally, we could develop a software tool for PCN 2.0 Diagrams representation to stimulate the use of this framework.

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How to Assess the Intellectual Capital of Firms in Uncertain Times: A Systematic Literature Review

Marcello Cosa*

Department of Economic and Social Sciences (DiSES)
Università Cattolica del Sacro Cuore
Via Emilia Parmense 84, 29122 - Piacenza, Italy

David Stuckler

Department of Social and Political Sciences
Università Bocconi
Via Sarfatti 25, 20100 - Milano, Italy

* *Corresponding author*

Abstract

Measuring Intellectual Capital (IC) is essential for contemporary firms. To succeed in a radically changed economic environment, organizations must develop reliable measures of IC.

Yet existing studies focused on this topic missed evaluating the uncertainty sources. To our knowledge, we performed the first systematic literature review with thematic analysis to understand which IC measurement model works better in the following uncertainty areas: digital transformation, environmental impact, financial crisis, social impact and turbulent environments. We searched three databases and included quantitative peer-reviewed articles relevant to IC measurement methods in business uncertainty. This yielded 2,709 studies, of which 27 were eligible and included in the final sample.

Our study found no agreement on the best IC measurement tool for uncertain times due to varying firm characteristics, including location, industry, size, and performance dimensions. Additionally, included studies emphasized the importance of human capital in enhancing company competitiveness and profitability. However, investing in IC alone cannot ensure agility and resilience in the digital era. Firms must effectively manage intangible assets like innovation, R&D, and employee knowledge and skills to drive growth. For future research, we recommend focusing IC measurement research on under-investigated industries, such as automotive, transportation, and hospitality, which require tailored IC measurement solutions. Furthermore, to highlight the broader societal benefits of effective IC management, research should also focus on measuring IC's impact on social development goals, such as ecological sustainability, fair employment and gender parity.

Keywords – Intellectual capital, Measurement, Business uncertainty, Human capital, Systematic literature review

Paper type – Academic Research Paper

1 Introduction

IC has enjoyed considerable attention in research and practice for over three decades. The current economy, which is highly competitive and digitized, has shifted attention towards intangible assets as companies strive to outdo each other in terms of innovation. Over the past 25 years, the investment share of intangibles has increased by 29% in the USA and ten European economies (Hazan et al., 2021). In 2018, IC made up 84% of all enterprise value on the S&P 500 (one of the most important US stock market indexes). This is a massive increase from 68% in 1995 (Aon-Ponemon, 2020).

Assessing IC provides firms with a better understanding of intangible assets' value, as traditional financial measures do not capture the value of these resources, such as knowledge, expertise, and relationships (Bontis, 1998). Evaluating IC also helps firms make more informed strategic decisions by providing insights into the organization's strengths and weaknesses and identifying areas for improvement (Edvinsson and Malone, 1997). Additionally, companies can identify and leverage their knowledge assets to improve performance, drive innovation (Sveiby, 2001), and foster knowledge sharing and collaboration (Roos et al., 2007). This makes the company more appealing to investors interested in the company's intellectual property and knowledge resources (Stewart, 1997).

While there is no universally agreed-upon definition of IC, literature widely acknowledges that IC comprises various components (Kianto et al., 2017; Asiaei et al., 2018). Here, by IC we refer to the combination of three elements, e.g., human, structural and relational capital (Edvinsson and Malone, 1997; Roos and Roos, 1997).

Previous research has suggested a need to better identify IC measurement models in the context of business uncertainty. Conventional financial measurement and reporting systems have failed to keep up with the external business environment transformations and how companies have reacted to those changes (Ashton R.H., 2005). Since entrepreneurs face numerous challenges in

turbulent and torn environments, measuring and leveraging IC has become vital to developing business resilience, thriving and surviving (Daou et al., 2019).

Given these uncertain conditions, several studies have focused on the multiple facets of IC in the past decade. For example, Jalonen's (2012) systematic review found that uncertainty is a pervasive and inevitable aspect of the innovation process, affecting various stages from idea generation to commercialization. This study gives a valuable perspective on the relationship between IC and innovation in firms. However, the author did not look at methodologies for appraisal IC. Other more recent studies (Ali et al., 2021; Lin and Edvinsson, 2021; Paoloni et al., 2023) provided a comprehensive overview of IC topics and suggested several potential gaps in IC Research. Still, this body of work has yet to consider the current inability of firms to predict any events that may lead to adverse outcomes as a result.

What are the most effective methods for measuring IC in uncertain business environments? Corporate performance goes beyond simple profit and includes social and environmental dimensions (Bititci et al., 2012). Our research question there for asks whether IC enhances social, environmental and financial firm performance. To answer these questions, we performed a systematic review with a qualitative synthesis of study findings on IC measurement in uncertain contexts.

2 Methods

We conducted a systematic review under the guidelines of Tranfield et al. (2003) and following the PRISMA checklist suggested by Moher et al. (2015).

2.1 Search Strategy

We searched Web of Science, Scopus, and EBSCO Business Source Ultimate on February 24, 2023.

To ensure the broadest coverage possible, we split the expression 'intellectual capital measurement' into two different keywords ('intellectual capital' and 'measurement') because several studies did not use the sentence 'intellectual capital measurement' in that exact order. Since intellectual capital is a broad concept with multiple meanings (Ramlee and Abu, 2004), we used different reference terms. Thus, we advanced on Evans et al. (2015) who suggested the following search terms: 'intellectual capital', 'intellectual asset', 'intangible asset', 'knowledge capital' and 'knowledge asset'. Finally, following (Paoloni et al., 2023),

we paired the abovementioned variations for intellectual capital with the keyword 'measurement*' (with the '*' wildcard to include both singular and plural versions). Table 1 represents the search strings used and the number of documents found.

Table 1: Database Source and Query Executed

Database	Search Query	No. of Documents
Web of Science	TS=("intellectual capital*" OR "intellectual asset*" OR "intangible asset*" OR "invisible asset*" OR "knowledge capital" OR "knowledge asset*") **AND** TS=("measurement*")	**870**
Scopus	TITLE-ABS-KEY ("intellectual capital*" OR "intellectual asset*" OR "intangible asset*" OR "invisible asset*" OR "knowledge capital" OR "knowledge asset*") **AND** TITLE-ABS-KEY ("measurement*")	**1,127**
EBSCO Business Source Ultimate	(TI ("intellectual capital*" OR "intellectual asset*" OR "intangible asset*" OR "invisible asset*" OR "knowledge capital" OR "knowledge asset*") OR AB ("intellectual capital*" OR "intellectual asset*" OR "intangible asset*" OR "invisible asset*" OR "knowledge capital" OR "knowledge asset*") OR KW ("intellectual capital*" OR "intellectual asset*" OR "intangible asset*" OR "invisible asset*" OR "knowledge capital" OR "knowledge asset*")) **AND** (TI ("measurement*") OR AB ("measurement*") OR KW ("measurement*"))	**712**

2.2 Inclusion and Exclusion Criteria

We drew on the work by Shinde et al. (2022) and adapted their framework for selecting articles. In detail, we defined our inclusion and exclusion criteria using the PICOT (Population, Intervention, Context, Outcome, Time) method as outlined in Table 2.

Table 2. Inclusion/Exclusion criteria

Parameter	Inclusion	Exclusion
Population	• Private firms • Micro-level analyses (organizational IC)	• Education, Healthcare, Public and NPO sectors • Meso- and macro-level analyses (global, national, regional and industry IC)
Intervention	IC measurement methodologies	• IC conceptualization and definition • IC reporting and disclosure
Context	Uncertain conditions and turbulent environments	Normal operating conditionings

Outcome	Financial and management performance (market value, innovation, sustainability, leadership, corporate governance, organizational learning, etc.)	Reporting and disclosure performance (annual reports' relevance, reliability, readability, understandability, stakeholders' information about companies, etc.)
Time	Studies produced in 1985–2023	Studies published before 1985

In summary, we focused on retrieving peer-reviewed quantitative studies analyzing IC measurement methods in private firms. We focused only on papers that considered the elements of uncertainty or turbulent environments that put long-term pressure on businesses (Brende and Sternfels, 2022), such as unstable commodity markets, increasing inflation, global health crises, climate-related hazards, significant changes in consumer behavior and industrial demands, and digital transformation (Banholzer et al., 2022). Only studies in English were included and papers were excluded if they focused on the IC conceptualization and IC research in universities, education, healthcare, non-profit and public sectors, as the experiences about these topics have been examined in-depth elsewhere (Marr and Moustaghfir, 2005; Buonomo et al., 2020; Paoloni et al., 2020; Quarchioni et al., 2022).

For our purposes, where we seek to identify how to measure IC in firms and its impacts on financial and management performance, we did not include studies that focused solely on the reporting and disclosure of IC. In addition, we excluded articles focused on meso- and macro-level analyses of IC (i.e., global, regional, and national levels). Finally, we set a timespan to exclude studies published before 1985, as the main contribution to the field of IC started to be published after that year (Marr and Moustaghfir, 2005).

Unlike most structured and systematic reviews in the field, we did not perform citation impact analysis because over 40% of articles included in our review have been published in the last three years. According to Dumay (2014), recent publications should be excluded from citation analysis since they need more time to be cited. Therefore, the article's impact analysis could have reported inaccurate results in our case.

Figure 1 depicts the flowchart for the selection process of the articles. After applying inclusion/exclusion criteria, the search yielded 27 studies for inclusion in our review (Table 3).

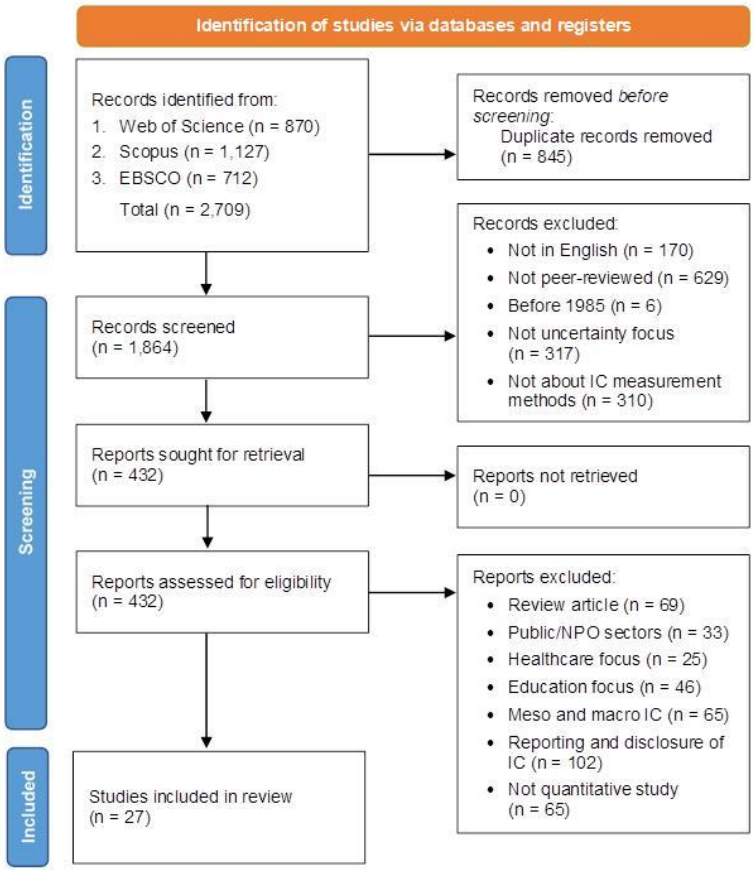

Figure 1. PRISMA flowchart for screening and inclusion

Table 3. The final sample of 27 quantitative articles included in the systematic review

Authors	Year	Journal	Main Findings
Al-Musali, M. Ismail, K.	2016	*International Journal of Islamic and Middle Eastern Finance and Management*	The impact of IC on bank financial performance indicators in Gulf Cooperation Council countries differs based on the VAIC™ components.
Asiaei, K. Jusoh, R. Barani, O. Asiaei, A.	2022	*Business Strategy and the Environment*	Green structural capital promotes environmental performance, while stakeholder relationships impact ecological performance through performance measurement.
Asiaei, K. O'Connor, N. Barani, O. Joshi, M	2023	*Business Strategy and the Environment*	Green IC is not associated with environmental performance in Iranian companies.

Bonsón, E. Escobar, T. Flores, F.	2008	*Financial Markets, Institutions and Instruments*	The significance of intangible resources for a firm's activities does not appear to influence the development or improvement of its information technology infrastructure.
Bozbura, F. Beskese, A.	2007	*International Journal of Approximate Reasoning*	The implementation rate of new ideas is the most important measure of organizational capital, and companies should foster a knowledge-creation culture.
Campisi, D. Costa, R.	2008	*Knowledge and Process Management*	Effective management of intangible assets can lead to competitive advantages and business growth, as evidenced by the relationship between innovation, R&D, training investments, and increased sales through launching new products.
Edvinsson, L. Kitts, B. Beding, T.	2000	*Journal of Intellectual Capital*	The digital landscape for IC allows for displaying the complexity of IC in a structured way, transferring knowledge, retrieving IC through exploration, planning investments and forecasting the firm future.
Iazzolino, G. Laise, D.	2016	*Journal of Intellectual Capital*	Traditional industries prioritize outdated knowledge over human capital investment, while non-traditional industries heavily invest in human resources for economic value creation but experience lower work productivity and higher employment rates.
Ishaq, M.I.	2021	*International Journal of Market Research*	The six-factor green brand equity scale is helpful for managers to track brand equity, allocate resources, and improve corporate image, trust, repurchase intentions, word-of-mouth communication, customer satisfaction, and brand loyalty.
Izzo, F. Tomnyuk, V. Lombardo, R.	2022	*International Journal of Manpower*	Fintech companies' profitability is not significantly affected by VAIC™, but human capital is crucial for knowledge-intensive companies in the digital era to enhance their competitiveness and profitability.
Jain, P. Vyas, V. Roy, A.	2017	*Social Responsibility Journal*	Corporate social responsibility (CSR) and firm performance are poorly related. The empirical data provide supportive evidence that IC profoundly impacts CSR and firm performance relationships.
Juma, N. Payne, T.	2004	*International Journal of Innovation Management*	The EVA™ showed a significant negative relationship to ROA performance but a slight positive curvilinear relationship to ROI performance, while the MVA™ showed a modest positive relationship to ROA and ROI performance.
Kale, S.	2009	*Journal of Construction Engineering and Management*	The Fuzzy Intellectual Capital Index (FICI) helps construction executives comprehend the connections between intangible assets and their movement within the organization.

Kozera-Kowalska, M.	2020	*Sustainability*	The Intellectual Sources of Value Added (ISVA) model is more effective than VAIC™ in Polish farms because it considers the productivity of tangible and intangible inputs that influence the value-adding process.
Liao, P.-J. Huang, C.-H. Hsu, K.-H.	2010	*International Journal of Services and Standards*	Companies in the exploitation stage prioritize employee satisfaction, turnover rate, and on-the-job training. Companies in the exploration stage prioritize engaging in strategic alliances as their most important activity.
Massingham, P. Nguyen, T.N.Q. Massingham, R.	2011	*Journal of Intellectual Capital*	The 360-degree peer review rating for human resources value measurement identifies training needs assessment, job analysis, performance appraisal, or managerial and leadership development.
Moutinho, V. Vale, J. Bertuzi, R. Bandeira, A.M. Palhares, J.	2021	*Economies*	Iberian banks' performance is largely determined by the efficiency of investing in the knowledge and skills of their human capital.
Ousama, A.A. Hammami, H. Abdulkarim, M.	2020	*International Journal of Islamic and Middle Eastern Finance and Management*	IC has a positive impact on the financial performance of Islamic banks. Among IC components, only capital employed and human capital have a significant impact, while structural capital exhibit an irrelevant effect.
Patel, P.C. Guedes, M.J.	2017	*International Journal of Tourism Research*	Higher return on intangible assets (ROIA) is linked to better performance for hospitality firms.
Peykani, P. Gheidar-Kheljani, J. Saen, R.F. Mohammadi, E.	2022	*Operational Research*	The Robust Window Data Envelopment Analysis (RWDEA) enhances decision-making reliability when dealing with data uncertainties and utilizing panel data.
Šebestová, J.D. Popescu, C.R.G.	2022	*Journal of Risk and Financial Management*	Most Czech companies invest only 20% of their profit in human resource development, which would yield a return of about 14%.
Śledzik, K.	2013	*Financial Internet Quarterly 'e-Finanse'*	Investments in human capital play a significant role in the IC of Polish banks, generating more value than investments in structural or capital employed.
Soetanto, T. Liem, P.F.	2019	*Journal of Asia Business Studies*	Both structural capital efficiency and capital employed efficiency have enhanced the Indonesian company's value creation. Although there is no significant relationship between IC and the firm's market value, in high-level knowledge industries, capital employed has a positive and significant relationship.

Soheilirad, S. Sofian, S. Mardani, A. Zavadskas, E.K. Kaklauskas, A. Darvishvand, J.M.	2017	*Engineering Economics*	Improving IC can boost corporate performance, while perceived environmental uncertainty can influence it. The corporate performance also has a positive correlation with capital structure. Additionally, the authors developed a new IC decision-making system.
Tarnóczi, T. Kulcsár, E.	2021	*Annals of the University of Oradea, Economic Science Series*	VAIC™ components positively influence firm profitability performance. IC has a more significant contribution to corporate value creation in Romanian companies than in Hungarian ones.
Tseng, K.A. Lan, Y.W. Lu, H.C. Chen, P.Y.	2013	*Management Decision*	IC significantly impacts Taiwanese business strategy and firm performance, including those from before and after the 2008 financial crisis. Business strategy partially mediates the relationship between IC and firm performance.
Turovets, Y.	2021	*Engineering Management in Production and Services*	Intangible assets effectively reduced inefficiency in various firms over time, but their impact decreased after the 2014 Russian crisis. High-tech firms benefit more from intangible assets, including research and development results, skilled personnel, and trade names.

2.3 Data Extraction and Analysis

We extracted the title, author, journal and year. We also extracted additional data from each article and used them to evaluate the risk of bias, including research question, quantitative methodology, sample size, time observation, industry, size of companies and main findings.

We performed a qualitative synthesis of uncertainty-related issues and findings. The 27 included studies analyzing alternative IC assessment models examined five areas of uncertainty: i) digital transformation, ii) environmental impact, iii) financial crisis, iv) social impact and v) turbulent environments. We also identified potential conflicting findings of the articles included in our final sample.

Data extraction was conducted by M.C. and then checked by D.S.

3 Results

We first present the overall characteristics of the 27 included studies. Next, we describe the main findings by the uncertainty context analyzed and the variations in study results.

3.1 Overall Characteristics of Included Studies

We reviewed four components of the organizational setting, including the location of firms, country economic development, industrial section and firm size.

Figure 2 depicts where the firms being studied were located and Figure 3 shows the number of studies by country. One study was multi-continent, involving Asia and Europe and three did not report any information about the location of their sample.

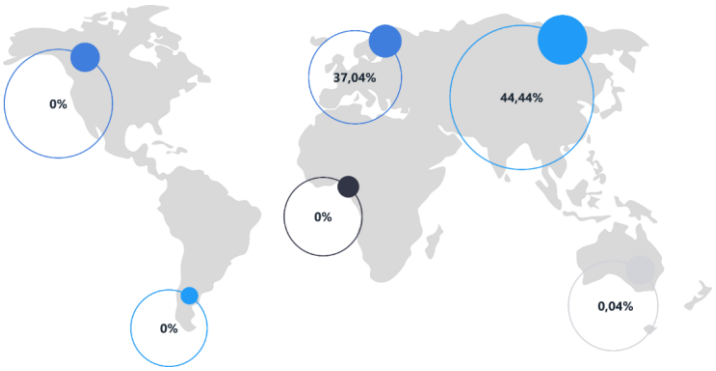

Figure 2. Continental distribution of studies

Notes: The figure shows the percentage of articles published in each continent. This graph does not include one multi-continent study and three studies that did not report geographical information.

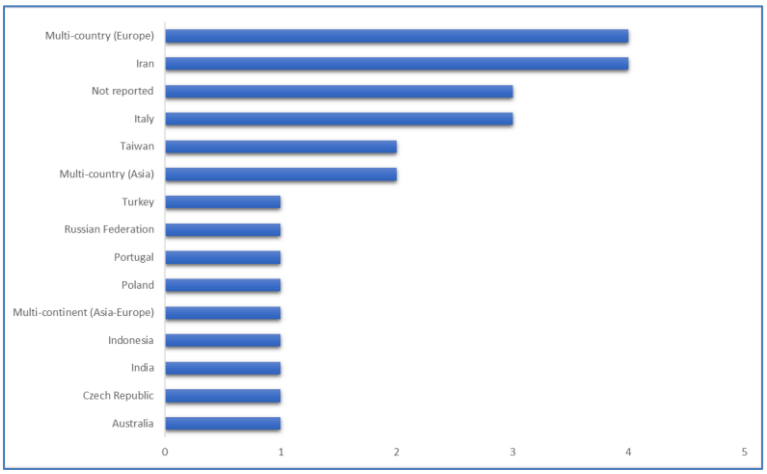

Figure 3. Number of studies by country

Following the new World Bank country classifications by income level (2022-2023), we found 14 out of 27 studies performed in high-income countries. Two studies were conducted in upper-middle-income countries and six in lower-middle-income countries. In addition, two studies analyzed countries with different income classifications. The remaining three did not report such data.

Figure 4 illustrates the industries investigated by the studies. Most articles focused on banks and financial companies (22,2%), followed by ICT firms (13,9%).

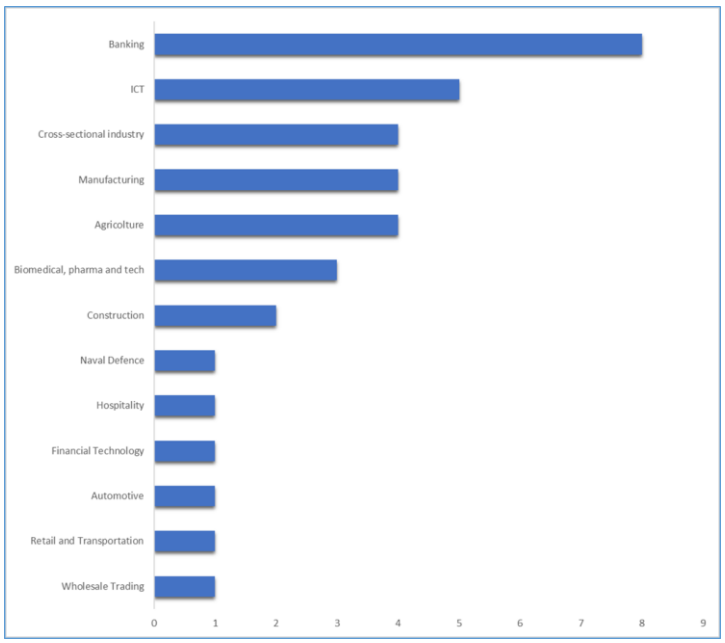

Figure 4. Industries investigated by the studies

We followed the World Bank standards to identify the size category of firms (International Finance Corporation, 2008). 21 out of 27 studies did not report the size of the companies. Two studies (Bozbura and Beskese, 2007; Ishaq, 2021) did not investigate firms, but they surveyed consumers or experts to validate their hypotheses. Of the remaining four studies that investigated firms, Campisi and Costa (2008) explored small and medium enterprises, two examined medium and large firms (Asiaei et al., 2022; Asiaei et al., 2023) and one analyzed medium firms (Kale, 2009).

3.2 Uncertainty Contexts

3.2.1 Theme 1: Digital Transformation (n = 4)

Four studies explored IC measurement methods in the shift from traditional organization operations to modern digital approaches.

Edvinsson et al. (2000) present and pilot a new IC measurement methodology (Digital IC-landscape) on 11 cross-sectional firms. They found that this method enhances strategic firm performance, including visually displaying the complexity of IC, transferring knowledge that affects IC, retrieving highly efficient IC through exploration, planning investments and forecasting the firm future.

Turovets (2021) analyzed the intangibles' effects on Russian manufacturing firms' efficiency from 2009-2018. Using Russian accounting standards for measuring intangibles, the author found that intangible assets robustly reduced inefficiency across different firms and over time. Still, the impact decreased after 2014, when Russia suffered a currency crisis, so investing in new technologies was more expensive. Moreover, high-tech firms receive a more significant effect on technical efficiency due to synergy between different intangible assets (research and development results, skilled personnel, trade names) and stable knowledge accumulation.

By evaluating the performance of Value Added Intellectual Coefficient (VAIC™) developed by Pulic (2000, 2004), Izzo and colleagues (2022) examined the impact of digital industrialization on human capital. The authors analyzed 10 Italian Fintech companies' financial information from 2016 to 2018. The study found that VAIC™ does not have a significant positive impact on Fintech companies' profitability. Among intellectual capital components, human capital plays a strategic role for knowledge-intensive companies looking to improve their competitiveness and profitability in the digital era.

Finally, Peykani et al. (2022) proposed a mathematical evolution of VAIC™ for assessing decision-making performance in a complex and uncertain data presence. They tested their model, Robust Window Data Envelopment Analysis (RWDEA), measuring the IC performance of 10 automotive and parts manufacturing companies from the Tehran Stock Exchange during 2013-2017. They found that the RWDEA model provides more reliable results for decision-making in the presence of large amounts of uncertain data to analyze.

3.2.2 Theme 2: Environmental Impact (n = 3)

Three studies examined the relationship between IC and firm environmental performance.

Asiaei et al. (2022) explored to what extent companies use environmental performance measurement to translate green IC into enhanced economic and environmental performance. The authors surveyed executives from 105 Iranian publicly listed medium-large companies. In detail, the sample included 8 IT companies, 17 banks, six agriculture firms and 74 manufacturing companies. They found that organizational resources such as technology systems, patents, and employees' knowledge enhance environmental performance and encourage performance measurement. However, stakeholder relationships impact ecological performance only when managers use environmental performance measurement.

Asiaei et al. (2023) used the same sample of firms of the previous study (2022). However, this time developed a different research question. The authors investigated whether the company's ability to innovate with green ideas (green IC) could improve its sustainable practices and environmental performance. They found no direct link between green IC and ecological performance. Therefore, Iranian companies may face challenges in establishing and maintaining green stakeholder relationships. Further, having more green resources like green human, structural, and relational capital can help promote green innovation in the company. Finally, innovative firms achieve better environmental performance.

The last study in the "Environmental impact" category proposed an original and validated scale to measure the brand green value that derives from consumer perception in a cross-cultural context (Ishaq, 2021). The author surveyed 980 consumers of telecommunication and home appliances, 452 in Italy and 528 in Pakistan, from August 2017 to February 2018. The author developed a six-factor green brand equity scale to measure the corporate image, trust, repurchase intentions, word-of-mouth communication, customer satisfaction and brand loyalty. Managers can use the scale to track brand equity and allocate resources efficiently and consistently. The ranking includes six dimensions: social influence, leadership, perceived quality, brand awareness, brand association, and sustainability. The "Green Brand Equity" worked well in both cultures as a green IC measurement method.

3.2.3 Theme 3: Financial Crisis (n = 7)

Seven papers evaluate the effectiveness of IC measurement methodologies in guiding firms to face the current economic downturn.

Bonsón et al. (2008) conducted a multi-country study involving 54 banking companies from Austria, Belgium, France, Germany, Greece, Italy, Ireland, Netherlands, Portugal and Spain. The study aimed to test whether the relative amount of intangibles on the entity's balance sheet implies the choice of a more advanced stage of sophistication for the banking/investment information system. The authors measured IC by Intangibles Ratio (Intangible Assets/Total Assets), analyzing annual reports dated to the 2005 year-end. They found that the importance of intangible assets in companies' operations does not seem to affect the evolution or enhancement of their information system.

Since IC assumes a strategic relevance for contemporary firms, Tseng et al. (2013) investigated how business strategy impacts the relationship between IC and financial performance. The authors analyzed 2,493 IT companies listed on the Taiwan Stock Exchange covering nine years, from 2001 to 2009. In detail, they measured IC through four metrics: i) operation profit per employee, ii) R&D intensity, iii) current capital turnover rate and iv) revenue growth rate. These metrics revealed that IC significantly impacts strategic and financial performance.

Patel and Guedes (2017) adopted the Return on Intangible Assets (ROIA) method for assessing the IC of 1,647 Portuguese hospitality firms from 2007 to 2014. The authors found that improving returns on fixed assets has the highest impact on operating profit, followed by gains from increasing returns from intangible assets.

Four papers focused on the association between IC measured by VAIC™ and firm performance in the banking industry.

Al-Musali and Ismail (2016) reported a strong positive association between VAIC™ and financial performance indicators (ROE and ROA) from 2008 to 2010 in a sample of 224 banks operating in the GCC countries. Likewise, a study by Ousama et al. (2020) used VAIC™ to assess the IC of 31 Islamic banks operating in the GCC countries from 2011 to 2013. Their results showed that IC enhances financial performance. In addition, the authors highlighted that the average IC is lower than that reported in other studies about Islamic banks operating in countries such as Pakistan and Malaysia. This may suggest that the GCC countries' Islamic banks might not fully leverage their IC. Moutinho et al. (2021) used VAIC™

to evaluate the performance of 58 Iberian banks (16 in Portugal and 42 in Spain) from 2013 to 2016. The authors reported that the effectiveness of investing in human capital's knowledge and skills mainly determines Iberian banks' global performance. Finally, Śledzik (2013) used VAIC™ to measure the IC efficiency of the 10 Polish-listed banks compared to 10 European financial institutions (Portugal, Hungary, Czech Republic, Croatia, Turkey, Romania, Denmark, Switzerland and Lithuania) from 2005 to 2009. The author reported that human capital efficiency primarily contributes to Polish and comparative banks' IC.

3.2.4 Theme 4: Social Impact (n = 6)

We identified three studies that asked whether human resource investments as a social development goal could help firms to build a more equitable and prosperous society.

Iazzolino and Laise (2016) introduced an accounting-based framework based on VAIC™ to assess the sustainability of knowledge-intensive and non-knowledge-intensive firms from a social perspective. They analyzed 1,000 Italian companies from 2010 to 2012. The authors found that traditional firms invest less in human capital than knowledge-intensive companies, which rely heavily on human resources for economic value creation. Šebestová and Popescu (2022) surveyed 278 Czech entrepreneurs through face-to-face, telephone and email interviews to explore their human capital investment strategies. The authors found that the largest group of companies (192) invests approximately 47.7% of generated profits, of which only 20% is directed toward human resources. They estimate that this human resource investment generates an annual return of about 14%. Finally, Massingham et al. (2011) performed an online survey of 118 engineering and technical workers of the Royal Australian Navy to address the subjectivity inherent in existing human capital value measurement methods. The authors proposed a new methodology that uses three data points: i) self-reporting, ii) 360-degree peer review and iii) personality ratings. Their results revealed more objectivity in human capital measurement involving quantitative and standardized techniques.

A study by Kozera-Kowalska (2020) asked whether IC promotes the shift of agricultural organizations toward sustainable development. This study aimed to demonstrate di inadequacy of VAIC™ for measuring the value creation in farms and propose a new metric called Intellectual Source of Value Added (ISVA). The author investigated numerical data from 120 Polish farms that delivered financial

reports from 2005 to 2018. Even though agriculture has been seen for years as a sector with low knowledge intensity and is skeptical about the possibility of using knowledge, the research concluded that agricultural enterprises possess IC resources and use them more efficiently than traditional ones. Therefore, ISVA is more suitable than VAIC™ because it considers the productivity of tangible and intangible inputs affecting the value-adding process in agricultural holdings.

Two studies in lower-middle-income countries analyzed the impact of IC on firm performance to achieve wealth creation and sustainability.

First, Soetanto and Liem (2019) investigated IC's influence on the market value and financial performance of 127 publicly listed firms in Indonesia from 2010 to 2017, using a modified version of VAIC™. The author reported that IC significantly and positively impacted firm performance. Specifically, intangible assets such as patents, trademarks, copyrights, databases, software, procedures, and organizational culture (structural capital) contributed to the company's value creation. Physical and financial capital (capital employed) exhibited the same results. Instead, this research found no significant relationship between IC and the firm's market value. However, when the sample was clustered into high-level and low-level knowledge industries, capital employed displayed a positive and significant relationship in the high-level industry. Second, Jain et al. (2017) surveyed 384 small and medium-sized enterprises in Rajasthan state (India) to investigate how corporate social responsibility affects a company's performance and whether this relationship is influenced by the company's IC and competitive advantage. Their findings showed that corporate social responsibility has a slightly positive effect on firm performance. The data suggested that IC plays an essential role in this relationship, but the mediating impact of competitive advantage is not significant.

3.2.5 Theme 5: Turbulent Environments (n = 7)

The studies in this group examined uncertainty in general terms. They focused on how IC affects companies operating in highly unpredictable and rapidly changing market or economic conditions with much uncertainty and volatility.

Three studies focused on IC's impact on financial performance.

Juma and Payne (2004) collected financial data of publicly traded firms operating in the biotechnology, computer hardware, computer software, and telecommunications industries from 1996 through 2001. The authors used Economic Value Added (EVA™) and Market Value Added (MVA™) to assess

intangible assets. Their analysis showed contrasting results. The authors argued that the EVA™ and MVA™ methods do not appear distinct enough from conventional performance measures to be useful for predictive purposes. Although they found some evidence to support an inverse relationship between EVA™ and IC, it is not a suitable IC measurement model.

Similarly, Campisi and Costa (2008) investigated the cause-effect link between IC management and business performance improvement. The authors conducted interviews with managers of 22 Italian small and medium-sized enterprises. Through a data envelopment analysis for IC management, the study findings indicated that simply investing more in intangible assets does not necessarily lead to better business performance.

Finally, Tarnóczi and Kulcsár (2021) performed a comparative analysis of VAIC™ analyzing data collected for five years (2014-2018) from 1,340 companies (653 in Hungary and 687 in Romania). The authors found that VAIC™ positively impacts firm profitability performance. Moreover, IC's contribution to corporate value creation in Romanian companies is more significant than in Hungarian companies' case.

Four studies developed new IC measurement models to guide firms in managing their intangible assets in turbulent environments.

The study by Soheilirad et al. (2017) distributed questionnaires to 339 publicly listed Iranian manufacturing companies. The survey took almost six months period from January 2014 to June 2014. The authors found that IC enhances corporate performance in terms of productivity improvement and creativity. Additionally, their results demonstrated that the perceived environmental uncertainty did not impact capital structure because Iranian manufacturing companies operate in uncertain environments without accurate information. Based on the works by Bontis (1998) and Ismail (2005), the authors developed a new version of the IC decision-making system called the Intellectual Capital Multiple Criteria Decision Support (ICMCDS) System. This scorecard model enables the decision maker to obtain various conceptual and quantitative information on IC to analyze different strategic performance dimensions and make efficient decisions.

Liao et al. (2010) identified 49 items in three IC dimensions, including human capital, structural capital and relational capital, based on interviews with 20 CEOs or senior managers in Taiwanese biopharmaceutical companies. In the exploitation stage, companies showed more concern for employee satisfaction,

turnover rate, and on-job-training. Engaging in strategic alliances was shown to be an essential activity for companies in the exploration stage.

Kale (2009) presented a construction business case study to illustrate the proposed model's implementation and utility, called the Fuzzy Intellectual Capital Index (FICI). The author reported that the FICI model is a flexible and robust tool that enables construction executives to understand the interrelationships between intangible assets and the movement of these intangible resources within the organization, such as knowledge sharing, collaboration, innovation diffusion, and employee training. It uses linguistic variables to represent inputs and outputs, making the evaluation process easier to interpret and improving communication. FICI can be used internally by firms to assess their knowledge assets and ability to meet strategic objectives and strategy formulation, implementation, and control. By rating and weighting IC criteria, leaders can identify critical indicators and understand how they relate to the firm's long-term strategy. Overall, FICI provides valuable information for construction executives to identify strengths, weaknesses, threats, and opportunities and address improvement areas to succeed in a competitive environment.

Finally, Bozbura and Beskese (2007) developed a method for improving the process of identifying and ranking the most crucial organizational capital measurement indicators when faced with uncertainty. The authors tested their model with an independent judgment by academics and professionals. The authors determined that the "Implementation rate of new ideas" is the most critical indicator for measuring organizational capital. Therefore, companies should prioritize implementing newly generated ideas and fostering a culture of knowledge creation within their organization.

3.3 Conflicting Findings

A deeper analysis of the papers revealed conflicting findings, as shown in Table 4. Different organizational characteristics affect the choice of a measurement method to use and influence IC's impact on firm performance. For example, Tseng and colleagues (2013) demonstrated that IC plays a prominent role in high-tech firms' financial performance. However, Juma and Payne (2004) and Izzo et al. (2022) reported opposite results: they did not find a clear relationship between IC and the profitability of high-tech companies. Therefore, while organizational

settings should have some correlation with the various IC assessment models, there is no one-size-fits-all method.

Additionally, different measurement models reported a varying range of results. For example, the most investigated IC measurement method was VAIC™, but its effectiveness in assessing IC needs to be clarified. While six studies reported that VAIC™ positively impacts firm performance (Śledzik, 2013; Al-Musali and Ismail, 2016; Iazzolino and Laise, 2016; Ousama et al., 2020; Moutinho et al., 2021; Tarnóczi and Kulcsár, 2021), other three studies highlighted the inability of the VAIC™ to reliably measure companies' IC (Soetanto and Liem, 2019; Kozera-Kowalska, 2020; Izzo et al., 2022).

Our analysis also indicates that the relationship between IC and social, environmental and financial firm performance is not clear. For example, Asiaei et al. (2022) first found that green organizational resources enhance ecological performance. Then, analyzing the same firms' sample, the authors found that the overall green IC is unrelated to environmental performance (Asiaei et al., 2023). This finding might be explained by the fact that too many variables are involved and the results of the included studies are conflicting.

Table 4. Conflicting Findings

Issue	Variations in Findings
Knowledge Intensive Industry	• IC significantly impacts information technology firms' business strategy and financial performance (Tseng et al., 2013). • In high-tech firms, there is no clear relationship between the measurement of IC and conventional financial indicators (Juma and Payne, 2004). • IC measured by VAIC™ does not have a relevant impact on the performance of the Italian Fintech companies (Izzo et al., 2022).
Firm Location	• Simply investing in IC did not improve corporate performance in the Italian biomedical industry (Campisi and Costa, 2008). • IC significantly and positively impacted Iranian firms' financial performance (Soheilirad et al., 2017) and Romanian and Hungarian firms' value creation (Tarnóczi and Kulcsár, 2021). • Despite demonstrated benefits, Czech business owners invest only 20% of their budget into human resources (Šebestová and Popescu, 2022).
Environmental Impact	• Organizational green resources enhance environmental performance (Asiaei et al., 2022). • Green IC and ecological performance are not correlated (Asiaei et al., 2023).
Value Added Intellectual Coefficient - VAIC™	• VAIC™ and financial performance indicators are strictly associated (Śledzik, 2013; Al-Musali and Ismail, 2016; Iazzolino and Laise, 2016; Ousama et al., 2020; Moutinho et al., 2021; Tarnóczi and Kulcsár, 2021).

	• VAIC™ does not measure relational capital that is the ability of an organization in collaborating with external stakeholders such as suppliers, customers, creditors and public administrations (Soetanto and Liem, 2019). • VAIC™ draws a false picture of the economic realities of firms with a high share of physical assets, like agriculture holdings (Kozera-Kowalska, 2020). • VAIC™ does not impact financial performance (Izzo et al., 2022).

4 Discussion

Our study aimed to explore how to measure IC in a climate of business uncertainty. Overall, we found no consensus about the best IC measurement tool. This lack of agreement appears to relate to considerable differences in firms' location, industry, size and performance dimensions (e.g., financial, social, environmental). Differing IC tools could yield markedly varying pictures of performance and, in some cases, contradictory patterns. Next, there is widespread recognition that human capital is a critical resource during business volatility; however, few IC tools currently incorporate human capital metrics such as employee satisfaction, turnover rate, on-job-training, and personality ratings.

As with all systematic reviews, ours has several important limitations. First, because of the heterogeneity between studies in the research questions, research setting and IC assessment methodologies examined, it was not possible to perform a meta-analysis. To address this limitation, we structured the review by uncertainty contexts, so permitting to highlight main patterns and key themes across study findings. Second, the review excluded qualitative studies because we looked for empirical applications of IC measurement methods in practice. We also excluded studies within the public or non-profit sector that could have contributed to the analysis. Third, the search focused on peer-reviewed articles. Excluding other sources may have been lost some studies. Nevertheless, we addressed this limitation by utilizing multiple databases and looking across a wide range of article focus. We did not restrict our search to journals with specific topics or rankings.

The studies themselves also had a series of weaknesses. The majority of studies focused on the IT and financial industries. There is a need in future studies to investigate other sectors, including automotive, transportation and hospitality companies, as these industries produce several social and ecological impacts. In addition, the studies did not cover all relevant locations equally; more than half of these involved high-income countries.

Notwithstanding these limitations, our study has key strengths. To our knowledge, this is the first systematic review focused on assessing IC in business uncertainty. While previous systematic reviews answered questions related to the IC, they did not specifically examine its measurement in uncertainty contexts. Similarly, other studies focused on the broader effect of uncertainty on the innovation process but did not explore methods for measuring IC in such situations.

Our research is consistent with existing IC research. First, we found that 63% of studies employed a wide range of indicators and methods for measuring IC. As Pedro et al. (2018) suggested, this highlights the importance of reaching a consensus and defining IC and its related metrics based on different analytical perspectives. Second, our geographical analysis aligns with Inkinen's (2015) observation that studies on IC did not equally encompass all relevant areas. Seven articles were multi-country despite the IC research concentration on Asia and Europe. However, the hegemony of these two continents in IC research seems quite evident. Third, although only three studies reported the sample size of firms, our findings confirm the common trend that IC research has primarily analyzed big companies (Cohen and Kaimenakis, 2007; Tovstiga and Tulugurova, 2007).

Finally, we also found that increasing investment in IC alone does not boost firms' resilience and agility in the digital era. Hence, IC measurement can help firms to face the digital transformation process only when they effectively manage their intangible assets, transforming them into competitive advantages and business growth (e.g., leverage investments in innovation, R&D and employees' knowledge and skills to increase sales by launching new products).

The systematic review highlights important research gaps. The organizational setting revealed that several industries, such as digital communication and tourism, need more investigation into IC measurement and management. Regarding Social Development Goals set by the United Nations, more research should be done on green development, decent work and gender equality to deepen the IC impacts, as reminded by Secundo et al. (2020). Future research is also needed to investigate the impact of IC assets on digital transformation performance. Importantly, two out of four studies that analyzed the digital transformation proposed innovative IC measurement models but did not evaluate or propose specific measurement instruments. It is possible to measure different performance improvements across the phases of digital transformation (Verhoef et al., 2021), yet none of the existing studies included this dimension.

Our findings have important implications for practice. The financial crisis that occurred in 2008 is still fresh in the minds of practitioners. During that time, numerous companies lost billions of euros in a single day, and the situation was deemed a crisis. Conversely, the current uncertainty could be considered a crisis of opportunity. For instance, the digital transformation market will exceed $1,549 billion by the end of 2027, according to MarketsandMarkets Research (2023). Moreover, if firms fight inflation, they can keep their employees motivated and establish a connection with their customers.

In times of tremendous uncertainty, firms increasingly need IC measurement to maneuver and respond quickly to changing economic and social circumstances. Companies risk being unprepared for unforeseen events without adequate measurement, especially around human capital. Assessing IC means measuring the "immeasurable" and our study suggests that there is no method that works in all cases. What really matters is measuring for learning and value creation. To help businesses navigate uncertainty, we encourage more strategic use of IC measurement by mixing financial and non-financial metrics, like social impact, environmental sustainability, employees' skills and creativity.

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Selling Experience in C2C E-Commerce of Second-Hand: Gen-Zers among Bargaining, Personal Satisfaction and Sustainable Lifestyle

Alessandro Iuffmann Ghezzi*

Catholic University of Sacred Heart
Fac. of Economics and Law
Via Emilia Parmense 84, Piacenza, Italy

Francesca Negri

Catholic University of Sacred Heart
Fac. of Economics and Law
Via Emilia Parmense 84, Piacenza, Italy

Greta Siracusa

LIUC - Università Cattaneo,
School of Economics and Management
Corso Matteotti 22, Castellanza, Italy

* *Corresponding author*

Abstract

The Covid-19 pandemic led to a significant increase in e-commerce and digital adoption in Europe, with online consumer-to-consumer (C2C) marketplaces for second-hand goods experiencing newfold popularity. This trend is primarily driven by Gen-Zers, who are leading the way in buying and selling second-hand goods online, motivated by saving/making money, finding unique items and adopting a more sustainable lifestyle.
This research aims to investigate Gen-Zers' attitudes towards online C2C platforms and their motivations for selling second-hand clothes.
In order to investigate this phoenomenon, a qualitative research method has been preferred. The study consists of two parts: the first involves a systematic collection and analysis of users' reviews of the Apps on Trustpilot and App stores in order to identify the most relevant drivers in determining the Circular Customer Experience (CCE) from the sellers' point of view, while the second part involves two focus groups to discuss the evidences emerged from the first study. The research perimeter includes the main Italian online C2C platforms for the clothing category (Vinted and Depop). The reviews were collected using web scraping software and a manual content analysis were conducted to

identify topics that emerged from the qualitative data. The focus groups were organized in light of the predominant role of the participants (sellers).
The results show that among Gen Z, the main motivation to sell is to "empty the closet" but the satisfaction of completing a transaction successfully is also important. Although sustainability is not the primary driving force behind the selling choice, some participants are concerned about sustainability and suggest that C2C platforms increase user awareness and provide solutions to be more responsible. The research highlights personal satisfaction and accomplishment as the key reason for sellers to stand out. Our findings suggest that C2C platforms can retain and attract sellers by improving the mobile experience, developing incentive systems to increase the propensity to leave reviews and equipping sellers with signalling systems to protect against buyers' opportunistic behaviours. In conclusion, to create a positive perception of second-hand goods, marketers should emphasize their environmental and psychological benefits. If C2C platforms make it easy, rewarding and eco-friendly to sell second-hand goods, they can change people's attitudes toward used items, so they will no longer be seen as inferior. To the best of our knowledge, this is the first study to adopt the sellers' point of view, specifically focusing on the motivations of Gen-Z, as the main users of these platforms.

Keywords – C2C, second hand goods, online platforms, Circular Customer Experience, Gen-Z

Paper type – Academic Research Paper

1 Introduction

The meteoric rise of e-commerce during the Covid-19 pandemic is a matter of fact which also boosted by 14 percent the digital adoption in Europe (Statista, 2023a), an increment that would have taken two or more years at pre-pandemic growth rates and is proving to be steady and stable as the global state of emergency recedes. In this context, B2C marketplaces such as Amazon have prospered while physical retailers struggled being slow to deliver, short on stocks or even entirely missing the online opportunity. Over the din, there has been another e-commerce history of success much less commonly told: the newfound popularity of online consumer-to-consumer (from now on, C2C) marketplaces hosting buying and selling activities of second-hand goods largely. Transaction volumes have climbed both on horizontal sites such as Facebook Marketplace and on vertical sites as well: Vinted, a Lithuanian and pan-European C2C platform for second-hand fashion and apparel items, is a prime example that have seen growth of more than 50 percent since the start of 2020 (McKinsey, 2021a).

The surge has been driven by millions of people who spent time during lockdowns selling online the unnecessary or the unwanted. It is no short-term trend and is now estimated to be worth 6 billion Euro, having doubled in 2020 and expected to grow at a double-digit rate (McKinsey, 2021b). People are buying more second-hand goods online primarily to save money but creating less waste and adopting a new sustainable lifestyle is silently driving this "behavioural shift" as well (Yeap, 2022); across Europe, fashion and apparel is the biggest second-hand category, both bought and sold on C2C platforms. Consumers of all ages are trading on C2C platforms but, behind a listing on Vinted, it is common to find a Gen Z-er: the youngest consumers, largely 15 to 24 years old, are leading the way, accounting for 43 percent of market volume today (McKinsey, 2023). According to a recent study carried out by the Spanish C2C marketplace Wallapop and Doxa, Gen-Zers are fueling growth into the online second-hand market as a smarter, cheaper and more sustainable way of shopping. On one hand, young consumers can afford higher-quality clothes and accessories without breaking the bank; on the other, they are empowered to give a second life to unwanted, unfitting or unnecessary purchases, easily listing them on a user-friendly C2C marketplace (Doxa, 2022). Money saving/making is coupled with the hunt for bargains and social interactions with peers in searching unique items that set Gen-Zers apart and showing that they are different. In the same way, buying and selling on C2C platforms give a second life to used goods and promotes responsible consumption in lengthening the life of products and avoiding over- and unsustainable production (Yeap et al., 2022).

With the notion of possession moving closer to that of sharing, the aim of this research is to dig deep into Gen-Zers attitudes towards online C2C platforms, with specific reference to those who actively use them to sell second-hand items. Our purpose (RQ) is twofold: in the first instance we identify the most relevant drivers in determining the Circular Customer Experience (CCE) from the seller's point of view; subsequently, we investigate whether and to what extent the role of sustainability was pivotal in these experiences. To do so, qualitative research methods have been preferred. The paper consists of two studies. The first provides a systematic collection and analysis (through content analysis) of users' reviews of the Apps on Trustpilot and the main App stores; the emerging evidences were then discussed in a second study that consisted of a set of focus groups with Gen-Zers where the role of sustainability was investigated in-depth.

2 Literature Review

Studies on second-hand shopping are limited. Existing research identifies a variety of factors that influence second-hand shopping such as economic necessity and price equity. Similarly, scholars have indicated that purchasing used goods is an efficient method for reducing waste and pollution (Khurana and Tadesse, 2019; Machado et al., 2019). As an example, in the past few years, the second-hand clothing business has grown steadily as more young buyers have become interested in vintage clothing (Su et al., 2019). This is due to the fact that environmental value is the most significant predictor of views toward used apparel (Padmavathy et al., 2019). In recent years, the market for second-hand goods has undergone a significant transformation with the rise of consumer-to-consumer (C2C) online platforms. C2C online commerce refers to online transactions between two users that involve the exchange of goods. Such transactions are carried out through various online marketplaces, including popular platforms such as eBay, Etsy, or Taobao, as well as auction websites (Statista, 2022). The proliferation of these platforms has made it easier than ever for individuals to buy and sell used items directly to one another, bypassing traditional intermediaries like thrift stores or pawn shops.

In even more recent times, there has been a shift towards mobile-based shopping platforms that encourage consumers to engage in C2C transactions without having to go through traditional business channels. The fashion industry has particularly benefited from this trend, offering new opportunities for both consumers and sellers (Johan et al., 2020) and C2C e-commerce has proven popular, especially among younger generations. Thus, social shopping platforms (e.g., Vinted and Depop) enable millions of sellers and resellers to develop their own, more or less "professional", virtual store and connect with consumers, thanks to rating, reviews and direct interactions between buyers and sellers that allow price bargaining and requesting for additional information, "social" elements far from the logic of todays' retail or e-commerce. In addition, buying and selling second-hand items incorporate several elements of sustainability, both economical and environmental.

Sustainability motivations mainly indicate consumers' concern for the environment, particularly in relation to sustainability issues and beliefs (Hamari et al., 2016). Consumers who care about the environment will question the necessity and usefulness of a product before making a purchase in order to safeguard the

environment and abstain from ecologically hazardous behaviour (Parguel et al., 2017). It has been proven that sustainability-inclined beliefs (Hamari et al., 2016; Kim & Yoon, 2021) positively influence attitude towards collaborative consumption. Environmentally conscious consumers are more likely to engage in sustainable clothing consumption (Diddi et al., 2019; Parguel et al., 2017; Styvén & Mariani, 2020). Parguel et al. (2017), for instance, argued that the environmental awareness of French consumers has prompted them to purchase used goods through C2C platforms such as the local Leboncoin. Consumers believe that their actions can help to reduce waste by recycling, extending product life spans, and resulting in a decrease in indulgent, unsustainable consumption (Parguel et al., 2017; Turunen & Leipämaa-Leskinen, 2015).

Economic motivations refer to consumers' price consciousness (Padmavathy et al., 2019). In early studies on thrift store purchasing, economic motivation had been emphasised extensively (Ferraro et al., 2016). Price-conscious consumers are more likely to purchase secondhand clothing (Yan et al., 2015) and are referred to as highly economically-oriented bargain hunters (Seo & Kim, 2019). According to Edbring et al. (2016), consumers who purchase second-hand goods, especially clothing, tend to avoid purchasing first-hand goods at original prices because they may be able to purchase branded goods for a lower price or higher-quality products for a lower price on the secondary goods market.

Consumption on C2C platforms shows how users have incorporated technology into their daily lives and are progressively forming a conscience about being good for the environment. Studies on consumers' purchases of used goods have been conducted (Guiot & Roux, 2010; Mohammad et al., 2021; Seo & Kim, 2019; Yan et al., 2015), but there are fewer empirical studies on consumers' online selling and reselling behaviour for particular used goods like apparel. The study by Chu and Liao (2007) presents a taxonomy of online consumer resale behaviour and its impact on both purchase and resale decisions. The authors distinguish between planned and unplanned resale behaviours and classify online resale behaviours into four types, including resale of extra purchase, resale after temporary ownership, unplanned resale, and disposition. The study defines planned resale as consumers' intention to resell a purchased item after using it for a certain period, with the expectation of future compensation if the item is successfully resold through an online auction site. On the contrary, unplanned resale is defined as situations where consumers think about reselling a product only after its purchase. The authors also found that consumers in the second-

hand market might be driven by non-monetary reasons, such as fun or a sense of achievement, leading to increased user loyalty and promising future prospects.

Furthermore, Herrmann and Soiffer (1984) identified various types of sellers in the context of "garage sales" including (1) professional resellers, (2) dabblers, who try out the garage sale experience for the first time, (3) regulars, who regularly dispose of unneeded household items and (4) housecleaners, who dispose of unwanted items from the home. Apart from professional sellers, amateurs also began to sell excess personal goods in flea markets to clear out space at home and earn a small amount of money. Thus, consumers engage in resale for both economic and house-cleaning reasons, as well as for emotional and social motivations such as avoidance of waste, environmental protection, socialising, achievement, or simply for fun (Chu and Liao, 2007; Herrmann and Soiffer, 1984).

As consumer behaviour continues to evolve, the motivations behind the reselling of goods have become more complex. Recent research has shown that emotional motivations are becoming increasingly important factors in the consumers' decision-making process. Emotional motivations for reselling were previously identified by several studies and include avoidance of waste (Herrmann and Soiffer, 1984; Jacoby et al., 1977), environmental protection (Herrmann and Soiffer, 1984), socialising (Cameron and Galloway, 2005; Herrmann, 2006; Herrmann and Soiffer, 1984), and achievement and entertainment (Herrmann and Soiffer, 1984). These motivations may help to explain why consumers may not engage in complex financial analyses when reselling items. In short, consumers may resell for various reasons, including economic and house-cleaning purposes, as well as emotional and social reasons. Therefore, motivations that drive consumers to engage in online resale differ from those of traditional offline second-hand shops. Consumer online resale behaviour is multifaceted, composed of different motivations, and results in various impacts on consumer resale decisions. These motivations include utilitarian benefits of making a profit, satisfying other needs for consumption, maximizing shopping strategy, hedonic dimensions of enjoyment and achievement, avoidance of guilty feelings, and socializing needs (Chu, 2013).

As the world faces growing concerns over the environmental impact of fast fashion, the importance of sustainability and ethical values is becoming increasingly prominent in consumer behaviour. The study by Park (2023) highlights that consumer behaviour on C2C online platforms for second-hand fashion products is heavily influenced also by their level of environmental

consciousness. Consumers who prioritize environmental sustainability and saving tend to view second-hand trading platforms as an effective way to recycle products and purchase good quality second-hand fashion products. In contrast, consumers with low environmental consciousness tend to use the platform for hedonistic and experiential consumption. This highlights the crucial role of second-hand sellers on C2C platforms. According to Styvén & Mariani (2020), sellers should emphasize their environmental and ethical motivations for selling second-hand online, going beyond purely economic motivations. This approach has the potential to start a dialogue between buyers and sellers, and even convince buyers to choose a seller based on their real ethical and sustainability values. By promoting the environmental benefits of second-hand purchases and prioritizing ethical values, this approach could encourage a shift towards more conscious and responsible consumption. Overall, this approach has the potential to raise awareness about the benefits of purchasing second-hand products and contribute to more sustainable and responsible behaviours, which is vital for the environment.

Several studies have been conducted to examine the reasons behind consumers' purchases of second-hand products (Koay et al., 2022; Ferraro et al., 2016; Guiot & Roux, 2010; Roux & Guiot, 2008) and to investigate the purchasing behaviour of second-hand clothing on C2C platforms (Yeap et al., 2022; Moriuchi & Takahashi, 2022; Padmavathy, Swapana & Paul, 2019). However, research on consumer online resale behaviour is still scarce. Keeping in mind these under-researched issues, this study addresses a major lacuna in the literature by identifying precursors of attitude toward selling used clothing on C2C platforms. In doing so, the paper provides a deeper, more current comprehension of consumers' propensity to sell used clothing via these online platforms.

3 C2C online resale motivations

Having to investigate aspects of which informants are only partially aware, also sensitive to the phenomenon of social desirability, qualitative research methods have been preferred. The paper involves two studies. The first consists in the systematic collection and analysis (through Content Analysis) of users' reviews of the Apps on Trustpilot and the main App stores. The purpose of this first study was twofold: to identify the most relevant categories/drivers in determining the Circular Customer Experience (CCE) and to investigate whether sustainability was

an element present in the ex-post evaluation of these experiences. Having collected these first set of CCE drivers, the subsequent study made it possible to discuss the evidence that emerged in a set of two focus groups, organized in the light of the predominant role of the participants (sellers).

The research perimeter included the main online C2C platforms, for the clothing category in particular (Vinted and Depop, therefore), in the Italian market (reviews and Focus Group were collected/conducted in Italian and afterward translated: transcripts are available upon request).

3.1 Design and Methodology: Study One

Having identified the research perimeter (*see Table 1*), the reviews were collected using web scraping software. For our purposes, reviews were considered valid if, even separately 1) described the sales experience 2) concerned the aspects of sustainability. Unfortunately, in many reviews it has not been possible to identify whether they were written by a seller, a buyer, or both. Then, a manual content analysis has been run: as suggested by Saldana (2015), this method enables to detect, examine and present topics emerging from qualitative data, and we were looking for the CCE drivers for sellers. The CCE drivers were clustered in the light of the four touchpoints discussed by Lemon and Verhoef (2016). The classification work was carried out independently, but to ensure objectivity of the analysis, a part of the dataset (30%) was randomly extracted and analysed by all the Authors: in most cases Authors' evaluations were congruent and aligned. The content analysis has been carried out following the criterion of completeness and exhaustiveness.

Table 1: Study One perimeter (March 2023)

C2C platform	**Vinted**	**Depop**
Trustpilot N° reviews	4.119	5.548
Trustpilot average rate	4.4 out of 5 stars	2.2 out of 5 stars
Apple store N° reviews	439.790	34.146
Apple store average rate	4.8 out of 5 stars	4.7 out of 5 stars
Google Play store N° reviews	1,04 Mln	62.553
Google Play Store average rate	4.4 out of 5 stars	3.9 out of 5 stars

3.2 Design and Methodology: Study Two

Study One results were the foundation for the Study Two: Focus Group interviews (Lederman, 1990; Creswell and Creswell, 2018) were appropriate for obtaining a broad range of opinions and beliefs about the subject and experiences, pointed out in Study One. Moreover, participants were supposed to readily express themselves when they are part of a group (Kitzinger 1994).

In April 2023, 13 Italian students aged 22–27 yo (*see Table 2*) participated in two online focus group sessions (via Microsoft Teams). The participants were selected using Authors personal networks (opportunistic sampling) according to the following criteria: 1) confidence with main C2C platforms as sellers, 2) normal use of the Internet as Gen Z (average rate of Internet usage in 2023 has been identified by Audiweb and WeAreSocial reports). Furthermore, two more control item have been introduced to select the participants profiles, as suggested by Fischer et al. (2017): they developed a specific scale for young consumers' sustainable consumption behaviours (YCSCB) in the areas of food and clothing, that has been used to measure the informant's profile. In collecting the availability to participate in the focus group studies, no incentives have been offered for participation (Van Laer et al. 2012).

The moderator adopted a soft-empathetic style of conduction making sure that the group dynamics facilitated the emergence of reliable information: through moderation, was ensured 1) the discussion of all points highlighted by Study One and by previous literature, and 2) a friendly and neutral environment, ensuring that everyone could express their thoughts trying to soften the double social desirability bias. Participants' privacy was ensured at the beginning of the meeting, specifying that any information would have been traced anonymously and in aggregate form. Furthermore, the authorization to record the conversations has been requested and obtained.

Table 2: Focus Groups participants (April 2023)

Participant	Age (yo)	Gender	Control item 1 (I buy my clothes myself)	Control item 2 (I get clothes as presents)	Control item 3 (Internet Usage – hours in a day)
1	23	Female	Yes	No	More than 5 h
2	23	Female	No	No	More than 5 h
3	22	Female	Yes	Yes	Less than 2 h
4	24	Female	Yes	Yes	Less than 2 h

5	24	Female	Yes	No	3 to 5 h
6	24	Male	Yes	Yes	3 to 5 h
7	23	Female	Yes	Yes	3 to 5 h
8	23	Female	Yes	No	3 to 5 h
9	23	Female	Yes	Yes	3 to 5 h
10	23	Female	Yes	Yes	3 to 5 h
11	24	Female	Yes	Yes	3 to 5 h
12	27	Male	Yes	Yes	3 to 5 h
13	25	Female	Yes	Yes	3 to 5 h

The focus group protocol was designed on literature review and Study One results, and included the following key questions: 1) CCE drivers from a seller point of view trough the different touchpoints 2) buying/consuming/selling behaviours 3) the role of sustainability in the seller CCE. Even if this is a small-scale study based on two focus groups, the results can be considered reliable, because the differences that emerge from the two moments of analysis are few and small. Focus Groups participants didn't take part in the online platforms analysed in Study One.

4 Findings

Study One

The objective of the first study was to highlight the different components of the seller-side CCE. The main points raised are listed below (Table 3). Brand-owned and Customer-owned touch points were the most discussed, especially in negative reviews.

Table 3: CCE drivers

Touchpoints (Lemon & Verhoef, 2016)	**Drivers**
Brand-owned touch points	platform operation and mobile app functioning, customer service assistance, pricing and payment system, advertising on the platform, loyalty programme
Partner-owned touch points	couriers, delivery/pick up points
Customer-owned touch points	request for pre-purchase support, false requests/non-purchases/rudeness, unplanned request (hand delivery, other platform with less fees)
Social/external touch points	customer word of mouth, platform and customer reviews

As far as the theme of sustainability is concerned, it does not appear often, but when present it is always linked to packaging.

Study Two

1) CCE drivers from a seller point of view through the different touchpoints.

With great clarity it emerged that selling is important, but even more is the experience sellers live in the meantime. In order of importance, there are three aspects that determine sellers' CCE: the feedback obtained from the buyer, which guarantees how excellent the seller has been (social/external touchpoint), the quality of the negotiation defined by the requests and behaviour of the buyer (customer-owned touchpoint) and the functioning of the platform (brand-owned touchpoint). The real boost of the sale is the satisfaction sellers bring home in managing, governing and concluding the negotiation.

2) Buying/consuming/selling behaviours.

Through moderation, the conversation covered the different stages of the customer journey. In particular, some confirmations of the literature have emerged but also some interesting new suggestions. Since the decision to sell clothes comes later than the one to buy, there is not any particular changes in the consumption behaviours. Only in the case of garments linked to events (ceremonies, for example) has it happened to use the garment with greater care so as not to preclude its sale after the usage. The reselling intention does not lead people to buy more or "better" (with reference to higher and durable quality, to have a longer life) nor to treat better what they buy.

Among the most interesting elements of this phase of the discussion there is certainly evidence of the reasons for which they sell. If the main motivation declared is to "empty the closet", the request to go deeper into the sensations associated reveals aspects that are not entirely foreseen. "Emptying the closets" for Gen Z means feeling less guilty about previous purchases, but also feeling smart. The ability to carry out a transaction in the best way, receiving gratifying reviews, the possibility of starting to become economically independent are the essence for using these platforms. All motivations that find their pivot in the characters of Gen Z. Being sustainable is a positive side effect, but certainly not the driving force behind the selling choice. A more functional reason that emerged side by side, but still linked to the age of the cluster considered, is that of no longer recognizing oneself in what is in own wardrobes: because one has grown up, and certain items no longer fit. Or because they have changed their

taste compared to when they were "little", or because of life changes (residence, lifestyle, broken relationships). What is obtained from the sales does not have a precise destination: in some cases, it is deposited into the current account, in others it is used to buy something else, both inside and outside the platform.

Finally, with reference to sales behaviour, sustainability concern appears in the use of recycled and/or easily recyclable packaging. In terms of timing, it clearly emerges that there is no rush to sell: the items remain on sale for a long time, without evaluating other solutions (such as charitable gift or elimination in the garbage).

3) The role of sustainability in the seller CCE.

During the focus groups, the topic of sustainability came up inconsistently. Some participants have immediately shown that they consider it, describing their shipping solutions, but it does not represent a priority. The shared feeling is that platforms should increase user awareness and equip sellers with tools and solutions to be more sustainable. It also emerged that during the transaction, one generally feels secure: the greatest perceived risks come from requests to leave the platform and/or the platform rules, which sometimes come from certain buyers. As commented in the previous point, the use of C2C platforms is not perceived as a behaviour mainly inspired by sustainability.

5 Conclusions and Implications

What makes a C2C platform appreciated by sellers is certainly its ease of use, mostly conveyed by a positive and user-friendly mobile experience. Sellers, regardless of their degree of experience on the platform, are aware of not being retail professionals and they do not want to be treated as such at any stage of the sale, from listing the object to identifying the most convenient shipping method. The research highlighted some features that can be enhanced to retain sellers and encourage a "buying and selling behaviour" to buying-only users; in particular, to improve Gen-Zers' Circular Customer Experience, C2C platforms are suggested to: (i) develop incentive systems to increase the propensity to leave reviews, indicated by interviewees as the key indicator of reliability for both sellers and buyers, as well as an "element of social gratification"; (ii) equip sellers with signalling systems or alerts against opportunistic buyers, fake profiles, and bogus requests that may discourage sellers from actively using the platform; (iii) push for greater awareness of what might be the most sustainable solution, for example,

by suggesting a donation to charity of long-unsold garments or proposing a local delivery solution for low-value items; (iv) suggest assisted saving systems with the proceeds of the sale to avoid overconsumption and promote a saving culture among younger sellers.In the same way, our research highlights personal satisfaction and accomplishment as the key reason-why to sell on C2C platforms. With this in mind, marketers may introduce forms of social recognition for best sellers to stand out as Airbnb did with "superhosts" to identify experienced and trustworthy hosts.

In the end, to create positive views of second-hand among buyers and sellers, marketers must emphasise the environmental and psychological advantages of used goods (Koay et al., 2022). However, it takes time to change people's perceptions of buying second-hand; working upstream, if directly selling the unwanted online via C2C platforms turns out to be easy, rewarding and environmentally sustainable, once a sufficient number of people will adopt this mentality, second-hand will no longer be regarded as second best.

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A Theoretical Tool for Evaluating the Circular Economy of Agrifood Companies

Benedetta Coluccia*

Department of Economics
University of Salento
Via per Monteroni, 73100, Lecce, Italy

Giulio Paolo Agnusdei

Department of Biological and Environmental Sciences and Technologies, University of Salento
Via per Monteroni, 73100, Lecce, Italy

Giuseppe Orlando

Department of Economics
University of Salento
Via per Monteroni, 73100, Lecce, Italy

Pamela Palmi

Department of Economics
University of Salento
Via per Monteroni, 73100, Lecce, Italy

* *Corresponding author*

Abstract

Global warming, pollution and the rapid absorption of natural resources require swift and immediate action to limit and reverse their impact on the environment. Circular economy offers a clear solution to addressing these global challenges. Therefore, measuring the circularity of one's organization should be the fundamental objective of all companies intending to apply circular economy. Otherwise, the effort made cannot be evaluated and the results achieved cannot be quantified.

The agri-food sector is considered one of the main challenges related to the achievement and application of Circular Economy (CE) strategies, therefore this study is aimed at developing a multilevel framework for assessing circularity in agri-food industries, by providing the user with a step-by-step approach. The framework is composed of four stages. In the first stage, a circular economy theoretical model, based on four criteria, was implemented and adapted to agri-food sector. In the second stage, a set of indicators

capable of measuring each criterion was collected. In the third stage, a weight is assigned to each indicator using the Analytical Hierarchy Process (AHP). Lastly, an Axial Distance-based Aggregated Measurement (ADAM) model is used to normalize, assess, and aggregate the results and produce final circularity scores. The model can be a useful tool to support corporate decisions concerning the circular economy, making entrepreneurs aware of their starting level. It indicates the extent to which companies are implementing circular business models across different dimensions, and thus where they are still lacking.

Keywords – circular economy; circular assessment; agri-food sector; business model; MCDM method; circular transition

Paper type – Academic Research Paper

1 Introduction

There is growing consensus on the need for a gradual transition to a more sustainable economic growth. Global warming, pollution and the rapid absorption of natural resources require swift and immediate action to limit and reverse their impact on the environment. Circular economy (CE), when applied to various business models across a variety of sectors and at different levels, offers a clear solution to addressing these global challenges (United Nations, 2019).

In recent decades, CE has emerged as a prominent topic in both natural science and management literature (Alhawari, et al., 2021). The CE concept came to the fore in 2010 thanks to the popular activity of the Ellen MacArthur Foundation (2015), which revived, among others, the most recent cradle-to-cradle approach (McDonough and Braungart, 2002). Since then, CE insights have never stopped going forward. However, since there is no single theoretical definition of CE, the originality and scope of new contributions on the subject have not always been clear, often making the concept confusing (Borrello et al., 2020).

Based on several scientific contributions, CE can today be defined as a regenerative system in which resource and waste inputs, emissions and energy losses are minimized by slowing down, closing and narrowing of material and energy loops (Boulding, 1966). Seen as a new business model, CE reconciles the relationship between economic development and environment protection, which is achieved through seven main actions: long life design, maintenance, repair, reuse, remanufacturing, reconditioning and recycling (Afuah and Tucci, 2003; Zott and Amit, 2010).

A growing interest in CE can be also highlighted in the EU policy looking for developing guidelines to support CE organizational strategies on the national level. In 2015, the European Commission launched a Circular Economy Action Plan (European Commission, 2015) to stimulate Europe's transition towards a more circular economy, to boost global competitiveness and to foster sustainable economic growth. Beginning with a limited focus on waste recycling, CE has steadily shifted to broad efficiency-oriented operations through an increase in the effectiveness of resource allocation, resource utilization and productivity, in a variety of areas, including agri-food (Su et al., 2013).

The application of CE principles in the agri-food sector appears to be an important and necessary change to transform society and face future challenges (European Commission, 2020).

The increasing global food demand, in fact, is forcing the agri-food companies to identify effective new strategies for production, distribution and consumption (Accorsi et al., 2019).

The agri-food value chain has many aspects to invest in to make production systems more sustainable and circular and resource recovery is only one of the most relevant aspects (Kyriakopoulos et al., 2019). CE, in fact, is a concept that is not limited to improving the sustainability of production processes, but enters into the organizational logic of the company, becoming a long-term goal whose progress must be monitored.

Therefore, measuring the circularity of a product or a process should be the fundamental objective of all companies intending to apply circular economy. Otherwise, the "profuse" commitment cannot be evaluated, and the results achieved are not quantifiable and, above all, comparable.

Measurement allows the entrepreneur to understand which actions to implement to improve circularity performance and which to avoid. It gives a contextualized dimension, in which to set improvement objectives.

2 Circular economy in agri-food companies

The agri-food sector is considered as one of the main challenges related to the achievement and application of CE strategies (Muscio and Sisto 2020). The agri-food sector includes activities of other industrial sectors and it is defined as a syneresis of several economic activities, such as natural processes managed by anthropic actions and industrial processes, fully under human control. This sector

is creating unsustainable resource consumption and waste creation, which has environmental, economic and social consequences (Agnusdei and Coluccia, 2022). The concept of CE within agri-food sector is becoming a challenge for researchers and practitioners and it is declined in the objectives of Sustainable Development Goals (SDGs) as it plays a key role in the transition to a sustainable food system. Responsible Consumption and Production is the key objective of SDGs in which sustainability strategies are applied to the agri-food sector. The interest in this field is also highlighted by the European Commission which is addressing the shift from a linear model to a circular model. Therefore, reducing food loss and waste along the whole supply chain can be considered the main action to achieving sustainability in the sector. Practitioners, scientists and policymakers are working toward food loss and waste reduction strategies adopting sustainable production and consumption approaches (Shafiee-Jood and Cai, 2016). However, circular economy can be applied to all stages of the agri-food chain: from the cultivation and processing of food to packaging, up to the management of waste and by-products. The latter represent a unique resource to produce biomaterials with several applications (Esposito et al., 2020). In addition to the important environmental benefits, applying a circular economy approach to the food sector makes it possible to obtain concrete industrial and economic advantages, such as an increase in capital inflow, the attraction of talents and aware consumers, the increase in brand value and the adaptation to constantly evolving European regulations (Mehmood et al., 2021). A circular economy approach in agri-food allows for the recovering of resources by significantly reducing the negative externalities of the production cycles. Among the applications proposed in the literature, actions aimed at reducing food waste throughout the supply chain receive the greatest attention (Agnusdei et al., 2022; Principato et al., 2019). Other authors have focused on reducing packaging, on its recycling and on preferring biodegradable materials (Meys et al., 2020; Silva and Pålsson, 2022; Guillard et al., 2018). An important trend has dealt with the improvement of efficiency along the entire supply and distribution chain (Cravero et al, 2021; Pagotto and Halog, 2016), giving new life to production waste, through recycling or revaluation of materials (La Scalia et al., 2021; Kapoor et al., 2020). Finally, many authors have valued the downstream stages of the supply chain, promoting the consumption of eco-sustainable foods and favoring a plant-based diet (Coluccia et al., 2021; Cappellozza et al., 2019).

3 Literature review and scope

There are no commonly accepted methods to measure circularity (Kristensena and Mosgaard, 2020). An increasing number of scholars and practitioners have focused on the assessment of the progress of CE initiatives and, accordingly, on the development of performance measurement tools (Vinante et al., 2019). However, literature shows that advanced research and data availability on CE assessment tools and indicators are lacking (Yazdani et al., 2021). Quite simply, developing a framework for assessing circular economy is a challenge that must be coupled with the collection of framework, metrics and indicators. This is because, developing the right framework and selecting the correct indicators that capture different CE practices is the essential starting point for measuring circularity (Kumar et al., 2019). The number of CE frameworks is relatively small, and most of them are missing some important CE oriented strategies (European Commission, 2015; Rainville, 2019). The available frameworks tend to focus primarily on physical parameters and materials circularity without considering other CE aspects such as policies and regulations, customers contribution, organizational aspects, and technological advancement (Chauhan et al., 2022). From the literature analysis, it emerged that many of the reviewed frameworks are not intended to assess the circularity, but rather focus on a very specific stage(s) or area(s) of a selected product or process, such as end-of-life and waste generation.

There are numerous studies using the Life Cycle Approach to measure circularity (Laso et al., 2016; Thakker and Bakshi, 2021; Ferreira and Fuso-Nerini, 2019; Avdiushchenko and Zajac, 2019; Coluccia et al., 2022).

Other authors have combined LCA with MCDM, which allows greater flexibility, allowing the user to choose his own set of indicators based on his measurement needs (Rocchi et al., 2021; Alamerew and Brissaud, 2019; Ahmed et al., 2022).

To date, it is very challenging to achieve a predefined set of standard indicators for CE at the micro level. This is mainly due to the unlimited variety of goals, objectives, characteristics and challenges that different companies, businesses and products have. Different sets of indicators have been developed by different organizations to capture the circularity of different products and processes (European Commission, 2021). However, even the different taxonomies only focus on the operational aspects of the circular economy, such as material flow and waste generation. It is therefore difficult to find a single complete set of indicators

that takes into account the environmental, organizational, economic, social and technological factors of the model that implements a circular business model (de Arroyabe et al., 2019).

At the institutional level, the best-known model is Circulytics (Ellen MacArthur Foundation, 2017). This tool measures the CE performance of companies' materials and water flow and other services provided along with energy use. However, the focus of the model is on the balance of the materials, without considering that circular economy is a process that includes governance and organizational aspects. Another assessment tool is the Cradle to Cradle Certified by Cradle-to-Cradle Products Innovation Institute (MBDC, 2021). The tool lacks flexibility even on the product level as it does not assess products that operate on non-renewable energy sources.

Most of the approaches proposed to assess circularity provide only partial information, mainly focusing on the analysis of environmental sustainability performance. In general, the available frameworks have recurring weaknesses, mainly revolving around their limited selection of indicators that fail to capture different aspects and phases of CE. Furthermore, a lack of assessment of circularity in the agri-food sector is evident, despite its complexity and its strategic role in the circular transition.

Beyond the attempts of measuring the firm's performance circularity, what is lacking is an approach that can assess the circularity status of a company in a holistic vision, considering the complexity and disruption of all circular economy principles.

In this context, this work is primarily aimed at developing a novel comprehensive circular economy assessment framework that is flexible, easy to use, and accurate when determining the best business organization choices that fit the circular economy model in agri-food companies. The developed model can be applied to the transformation and industrial processes, thus excluding the agricultural and consumption phases. The literature gaps are addressed by providing the user with a step-by-step approach, leading up to the selection, weight and use of a customized set of indicators that are capable of accurately assessing the level of CE.

4 Theoretical model

This section describes the approach for the evaluation of agri-food firms in terms of circularity using a novel assessment framework. As shown in Figure 1, the framework is composed of four stages. In the first stage, through the analysis of the literature, a theoretical model which provides a holistic vision of the circular economy was implemented and adapted to the agri-food sector, as presented in Section 4.1. In the second stage, users are required to collect a set of indicators capable of measuring each sub-criterion, as presented in Section 4.2. In third stage, a weight is assigned to each indicator using the Analytical Hierarchy Process (AHP), which is a pairwise comparison methodology (Section 4.3).

Lastly, a geometric Multi Criteria Decision Making (MCDM) method, called the Axial Distance-based Aggregated Measurement (ADAM) model is used to normalize, assess and aggregate the results and produce final scores for the different alternatives to be ranked based on their final circularity scores (Section 4.4).

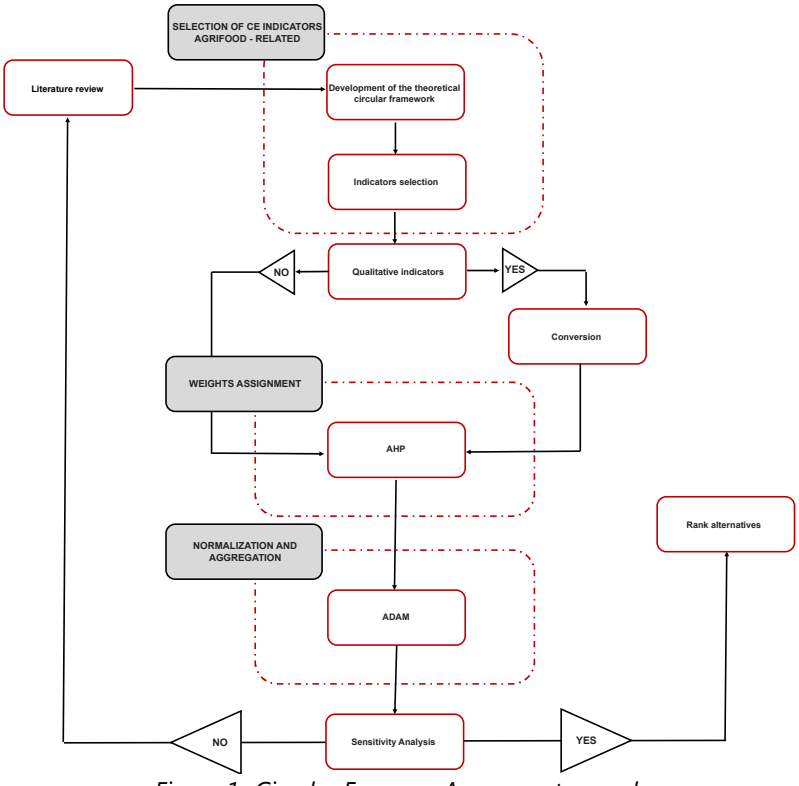

Figure 1- Circular Economy Assessment procedure

4.1 Development of a theoretical circular framework

In this first phase a theoretical framework was developed, thus providing the basis for the selection of criteria and sub-criteria of the general model. Through the analysis of the literature, the methodological framework of Lacy et al. (2020) was selected. It provides a holistic vision of circular economy, indicating the strategic areas that need to be considered to assess the level of circular maturity of companies, in order to ensure a reliable assessment:

- *Operations (OP)*: evaluating the value lost through the operations and by-products of business processes across energy, emissions, water and waste.
- *Products and services (PS):* rethinking the design, lifecycle, and end of use of a product or service to optimize usage, eliminate waste and close product loops.
- *Culture and organization (CO):* embedding circular principles into the fabric of an organization through redefined working practices, policies, and procedures.
- *Ecosystem (EC)*: collaborating and partnering with public and private sector actors to create an enabling environment for collective transformation.

In the present study, each of the above four dimensions was used as criteria for the evaluation of circular economy in agri-food firms. All these criteria are composed of sub-criteria (Table I), which can be measured using a set of indicators that are thought to be important for a valid evaluation of the circularity of agri-food firms.

The *operations* criterion was investigated taking into account four main sub-criteria in which companies typically focus their circular operational initiatives: energy (OP_1), emissions (OP_2), water (OP_3) and waste (OP_4).

Circularity in terms of *products and services* (PS) was evaluated by considering the four key stages of a product's lifecycle as sub-criteria: design (PS_1), use (PS_2), use extension (PS_3) and end of use (PS_4).

In order to evaluate the circular *culture and organization* (CO), we focused on the following four sub-criteria: vision (CO_1), innovation (CO_2), people (CO_3) and governance (CO_4).

Finally, we define a circular *ecosystem* as the network of organizations collaborating and partnering to create an enabling environment for collective

transformation. Therefore, in order to capture the potential of the ecosystem, we selected four key sub-criteria: sharing (EC_1), collaboration (EC_2), investment (EC_3) and policy (EC_4).

Table I. Description of criteria and sub-criteria

Criteria	Sub-criteria	Description
Operations (OP)	**Energy - OP_1**	Implementing measures that reduce energy consumption, increase operational energy efficiency, and start to shift from fossil fuels to renewable sources.
	Emissions - OP_2	Identifying emission points within the direct scope of core operations as well as throughout the supply chain and then making suitable interventions to reduce those emissions.
	Water - OP_3	Reducing a company's water dependence by minimizing water abstraction, prioritizing water-saving opportunities and increasing water reuse to improve efficiency and reduce costs.
	Waste - OP_4	Reaching zero waste by eliminating waste leakage throughout company operations and reducing waste capacity by maximizing asset utilization.
Product and Services (PS)	**Design - PS_1**	Conductive assessment of the current lifecycles of materials and their resource footprints.
	Use - PS_2	Maximizing the value delivered through the single use of a circular product or service in its original form. The aim is to leverage a product as a service or sharing platform model to maximize product utilization.
	Use extension - PS_3	Maximizing the value delivered through multiple uses of a circular product or service in its original form.
	End of use - PS_4	Maximizing the value delivered through multiple uses of a circular product or service in any form. This might include identifying circular uses for waste at end of use and repurposing it by recycling.
Culture and Organization (CO)	**Vision - CO_1**	Setting a long-term goal with milestones and supporting targets to become a circular organization over time.
	Innovation - CO_2	Breaking down research and development silos to encourage innovation across the organization, instilling a "laboratory" mindset to drive innovative circular thinking, sharing best practices and relevant use cases, conducting learning expeditions to embed circular principles and design in organizational centers of innovation and encouraging the operational and product/service pivot to circularity.
	People - CO_3	Engaging employees with circular projects sponsored from the top of the organization, providing training and internal support systems for those workers by identifying and empowering the people who can drive the journey of change and incentivizing circular

		performance at all levels against clear and challenging KPiS.
	Governance - CO_4	Making the circular economy a core element in the company's ways of working and structure by embedding circularity in policies, processes and procedures.
Ecosystem (EC)	**Sharing - EC_1**	Non-competitive, transparent sharing of knowledge, information, and learning to support circular thinking and performance. Initiatives in this area center around sharing insight and expertise with peers to address shared challenges.
	Collaboration - EC_2	Bilateral and multilateral partnerships to deliver practical circular solutions, Initiatives in this area focus on establishing bilateral partnerships and working with multilateral public-private stakeholders to bring to market circular solutions that benefit all.
	Investment - EC_3	Financial support to drive circular innovation. The investments can be in innovative start-ups, products, and business-model development, thought leadership, R&D, and non-commercial third parties such as NGOs or academia.
	Policy - EC_4	Support of an enabling regulatory environment for circularity. Initiatives in this area include engaging in local and national discussions as well as international forums to inform and/or influence relevant policy measures and regulations that would foster a regional and global circular economy.

According to Lacy et al. (2020), through these dimensions it is possible to detect the degree of circularity of a firm, understood as the extent to which it is implementing circular business models for all four dimensions. Necessarily, to reach an advanced level of transformation, companies should not dwell on just one dimension but will have to implement the new models on all of them in parallel.

4.2 Indicators selection

In this phase, indicators that are suitable for assessing the level of circularity achieved in each criterion and sub-criterion (non-existent, emerging, consolidated, lead and last) were identified. Table II summarizes the different indicators that users of the proposed framework should consider to be able to obtain a comprehensive choice of indicator set, consistent with the objectives of the circular economy in agri-food companies. To end up with a reliable set of indicators, the set should be targeted, measurable (even qualitative indicators

should have defined qualities using words like "successful, appropriate, effective"), reliable, feasible and utile in decision making (Church and Rogers, 2005).

Table II - Indicators to be selected for the circular economy assessment in agri-food firms

Criteria	Sub - criteria	Indicators
OP	OP_1	1. Energy consumption
		1. Energy renewable sources / Total Energy Consumption
	OP_2	2. Water consumption
		3. Blue Water footprint
		4. Green Water footprint
		5. Grey Water footprint
	OP_3	6. Waste production
		7. Food waste production
		8. Recycling rate
		9. Recycling rate of overall packaging
		10. Recycling rate of plastic packaging
		11. Recycling rate of wooden packaging
		12. Recycling rate of paper packaging
		13. Recycling rate of glass packaging
		14. Recycling rate of bio-waste
		15. Recycling rate of e-waste
	OP_4	16. Carbon footprint
		17. Imported raw materials
PS	PS_1	18. Use of software/management to process data to support business decisions
		19. Energy class of electronic equipment
		20. Food loss
		21. Packaging quality
		22. Quality of equipment
	PS_2	23. Percentage of exploitation of agricultural raw material
		24. Throughput time
		25. Supply chain certifications
	PS_3	26. Use of recycled materials for primary or secondary packaging
		27. Use of biodegradable materials for primary or secondary packaging
	PS_4	28. Food waste or by-products disposed of
		29. Food waste or recycled by-products
		30. Food waste or by-products processed by other industries to obtain new products

		31. Food waste or by-products used for energy production
CO	CO_1	32. Goals of circularity in the company's long-term planning
	CO_2	33. Investments in innovation
		34. Use of digital technologies for process efficiency
		35. Use of digital technologies for process traceability
	CO_3	36. Performance monitoring system through KPIs
		37. Capacity building: organization of courses, events and campaigns to educate employees on circularity
	CO_4	38. Circular orientation: the circular economy is a component of the company's sustainability policy
		39. Ownership of environmental quality and sustainability brands for products and services
EC	EC_1	40. Sharing of environmental performance results with competitors through platforms, calling of forums, consortia, hubs
		41. Sharing of equipment/machinery with other neighboring producers
	EC_2	42. Activities, involving all actions related to co-operation among different actors for synergies, projects, and workshops to boost a circular economy
		43. Participation in panels for the construction of sector policies
	EC_3	44. Funding of initiatives to drive circular innovation of start-ups, research centers or universities
	EC_4	45. Membership in trade associations
		46. Membership in business networks
		47. Belonging to public or private partnerships for research and identification of circular economy measures

4.3 Conversion of qualitative indicators

The normalization process is applied to the previously gathered data to convert qualitative indicators to scores. Other quantitative indicators pass directly to the fourth stage where the assigning of weights to indicators takes place through AHP methods. In this stage, for each qualitative indicator five scores are defined which correspond to the five levels of circular maturity identified in the literature: non-existent, emerging, established, leading and ultimate, as shown in Table III (Lacy et al., 2020). These levels present a progression associated with the stage of consolidation of the circular economy practices adopted by the organization. The more professional the management, the more consolidated the practices adopted

tend to be. Each level of circularity demands the formalization of a set of practices that contribute positively to making the agri-food firms circular.

Table III – Conversion to score

Linguistic term	Score
Non-existent	1
Emerging	2
Established	3
Leading	4
Ultimate	5

4.4 Assigning weights to indicators through AHP

The AHP method was developed by Thomas Saaty for analyzing complex problems in different decision-making scenarios. The AHP generally consists of three main steps namely, decomposition of the problem, comparative judgment and generation of priorities (Janic and Reggiani, 2002). The main aim of the AHP method is to develop a hierarchical structure with the main goal at the top level, the criteria, or attributes (Indicators), are placed at the second level and the alternatives at the bottom level. For this framework, no priorities are generated since the AHP method can only be used to define weights. Therefore, the first step in the AHP is aimed at constructing a pairwise comparison matrix P_{AHP} (w*w) with the indicators aligned in the first row and the first column in the same order, as seen in Table IV.

Table IV – Pairwise comparison matrix

	Indicator 1	**Indicator 2**	**Indicator w**
Indicator 1	1	1/a	1/b
Indicator 2	a	1	1/c
Indicator w	b	c	1

The same procedure is applied to the indicators belonging to each sub-criterion and to the sub-criteria belonging to each criterion. In the second step, a group of experts decide the comparative relative importance of among indicators, sub-criteria and criteria, in order to perform judgement for pairwise comparisons. The group of experts should be composed of a variable number of individuals

who know the circular economy, but who are external to the organization, in order to provide a competent but not biased view.

Same indicators will have a relative importance of 1 as illustrated in Table 4. Other indicators are given a number from 2 to 9 and reciprocals are given to same indicators when the order is switched as seen in Table V.

Table V – AHP intensity of importance table

Linguistic term	**Intensity scale**
Equal importance	1
Very Low	2
Low	3
Fairly Low	4
Medium	5
Fairly High	6
High	7
Very High	8
Extremely High	9

These values represent the relative importance of one alternative when compared to other keeping one indicator fixed (Singh and Malik, 2014). A normalized element is then obtained using Eq. (1).

$$r_{ij} = \frac{p_{ij}}{\sum_{i=1}^{w} e_{ij}} \quad (1)$$

where p_{ij} is an element of the original matrix PAHP (w*w) and the denominator is the summation of all the elements in the respective column. Finally, the weight vector is obtained using Eq. (2).

$$\boldsymbol{w} = \frac{1}{N \sum_{i=1}^{N} r_{ij}} \quad (2)$$

where N is the number of alternatives (Singh and Malik, 2014).

Subsequently, the weights obtained from the comparison between the indicators must be multiplied by the weights of the respective sub-criteria and criteria, thus obtaining the final evaluations.

4.5 Normalization, aggregation, and final rank using the ADAM method

ADAM method represents a new class of MCDM techniques, known as geometric MCDM (Krstić et al., 2023). This approach rates alternatives by computing the volumes of complex polyhedra made up of points (vertices) in a three-dimensional coordinate system as an aggregate measurement. Each point belongs to one of three classes: coordinate origin (O), reference points (R), weighted reference points (P). The coordinate origin is a coordinate point (0,0,0). Reference points in the x-y plane are points with the coordinates (x,y,0) that establish the value of the alternatives based on the four different CE orientations, such the point's axial distance from the coordinate origin. The weighted reference points have coordinates (x,y,z), where the coordinate z is used to obtain the axial distance of the weighted reference point from the x-y plane. These distances correspond to the weights of the indicators. A complex polyhedron volume can be calculated by summarizing the volumes of the m polyhedral (where m is the number of alternatives), by defining all the points that define it. According to the decreasing values of the obtained volumes of complex polyhedra, the final order of alternatives is determined. The step-procedure of this approach is given as follows.

Step 1*:* Define the decision matrix E, elements of which are evaluations e_{ij} of the alternatives i (A1, …, Am) in relation to indicators j (S1, …, Sn, W1, …, Wn, O1, …, On, T1, …, Tn), i.e., vector magnitudes which correspond to the evaluations of the alternatives in relation to the indicators:

$$E = \left[e_{ij}\right]_{m\times n},$$

where m is the total number of alternatives and n is the total number of indicators.

Step 2*:* Define the sorted decision matrix S, in which the evaluations e_{ij} are sorted in the descending order according to the importance (weight) of the indicators:

$$S = \left[s_{ij}\right]_{m\times n},$$

Step 3: Definition of the normalized sorted matrix N, in which the elements n_{ij} are normalized as:

$$n_{ij} = \begin{cases} \frac{s_{ij}}{\max_i s_{ij}}, & forj \in B \\ \frac{\min_i s_{ij}}{s_{ij}}, & forj \in C \end{cases},$$

where B is the set of benefit, and C is the set of cost criteria.

Step 4: Find the coordinates (x, y, z) of the reference (R_{ij}) and weighted reference (P_{ij}) points that define the complex polyhedron in the following way:

$$x_{ij} = n_{ij} \times \sin \alpha_j, \forall j = 1, \dots, n; \ \forall i = 1, \dots, m,$$
$$y_{ij} = n_{ij} \times \cos \alpha_j, \forall j = 1, \dots, n; \ \forall i = 1, \dots, m,$$
$$z_{ij} = \begin{cases} 0, forR_{ij} \\ w_j, forP_{ij} \end{cases}, \forall j = 1, \dots, n; \ \forall i = 1, \dots, m,$$

where w_j is the indicators weight and α_j is the angle that determines the direction of the vector that defines the value of the alternative.

Step 5: Find the volumes of complex polyhedra V_i^C as the sum of the volumes of the pyramids of which it is composed using the following equation:

$$V_i^C = \sum_{k=1}^{n-1} V_k, \forall i = 1, \dots, m \quad (9)$$

Step 6: Rank the alternatives according to the decreasing values of the volumes of complex polyhedra V_i^C $(i = 1, \dots, m)$. The best alternative is the one with the highest volume value.

5 Example of the implementation of the framework

This section presents an example intended to present briefly how the assessment procedure is to be used. It is also intended to help users understand the results they obtain from the assessment framework, and accordingly, draw conclusions on the circularity and point out possible areas of improvement within processes or products assessed.

In this example, four agri-food industries with four different circular orientations were compared: Operation orientation (A_1), Product and Services orientation (A_2), Culture and organization orientation (A_3), Ecosystem orientation (A_4). Each of the four companies has decided to implement circular economy actions by focusing on one of the four dimensions. The first step in assessing

circularity consisted in collecting the information needed to calculate the 48 indicators. The information was obtained through direct interviews with the operators of the four companies. Immediately after the calculation, since it is a mix of qualitative and quantitative indicators, they were subjected to the conversion process in the five levels of circularity, with the respective scores indicated in Table 4. Subsequently the indicators were normalized in the sorted matrix, as indicated in Equation 5.

The next step is assigning weights to the indicators through AHP method, as illustrated in Section 4.4. The weight obtained for each indicator, based on each criterion and sub-criterion, is presented in Table VI.

Table VI – Weighted obtained used AHP method

Indicators		**Weights**
1.	Energy consumption	0.0227
2.	Energy renewable sources / Total Energy Consumption	0.0202
3.	Water consumption	0.0031
4.	Blue Water footprint	0.0061
5.	Green Water footprint	0.0019
6.	Grey Water footprint	0.0192
7.	Waste production	0.0083
8.	Food waste production	0.0047
9.	Recycling rate	0.0098
10.	Recycling rate of overall packaging	0.0107
11.	Recycling rate of plastic packaging	0.0191
12.	Recycling rate of wooden packaging	0.0066
13.	Recycling rate of paper packaging	0.0088
14.	Recycling rate of glass packaging	0.0155
15.	Recycling rate of bio-waste	0.0062
16.	Recycling rate of e-waste	0.0155
17.	Carbon footprint	0.0800
18.	Imported raw materials	0.0160
19.	Use of software/management to process data to support business decisions	0.0049
20.	Energy class of electronic equipment	0.0034
21.	Food loss	0.0043
22.	Packaging quality	0.0093
23.	Quality of equipment	0.0093
24.	Percentage of exploitation of agricultural raw material	0.0130
25.	Throughput time	0.0022
26.	Supply chain certifications	0.0043
27.	Use of recycled materials for primary or secondary packaging	0.0383
28.	Use of biodegradable materials for primary or secondary packaging	0.0383
29.	Food waste or by-products disposed of	0.0269

30.	Food waste or recycled by-products	0.0122
31.	Food waste or by-products processed by other industries to obtain new products	0.0300
32.	Food waste or by-products used for energy production	0.0539
33.	Goals of circularity in the company's long-term planning	0.1293
34.	Investments in innovation	0.0155
35.	Use of digital technologies for process efficiency	0.0406
36.	Use of digital technologies for process traceability	0.0089
37.	Performance monitoring system through KPIs	0.0135
38.	Capacity building: organization of courses, events and campaigns to educate employees on circularity	0.0067
39.	Circular orientation: the circular economy is a component of the company's sustainability policy	0.0178
40.	Ownership of environmental quality and sustainability brands for products and services	0.0178
41.	Sharing of environmental performance results with competitors through platforms, calling of forums, consortia, hubs	0.0243
42.	Sharing of equipment/machinery with other neighboring producers	0.0728
43.	Activities, involving all actions related to co-operation among different actors for synergies, projects, and workshops to boost a circular economy	0.0323
44.	Participation in panels for the construction of sector policies	0.0162
45.	Funding of initiatives to drive circular innovation of start-ups, research centers or universities	0.0668
46.	Membership in trade associations	0.0076
47.	Membership in business networks	0.0076
48.	Belonging to public or private partnerships for research and identification of circular economy measures	0.0227

After obtaining the weight of each indicator, the ADAM method was used to aggregate and rank the data obtained from the indicators and present a final circularity score for each circular orientation, as highlighted in Section 4.5. Results are shown in Table VII.

Table VII – Final ranking

Alternatives	**Volume**	**Rank**
A1	0.003871236	2
A2	0.003410277	4
A3	0.003986811	1
A4	0.003795765	3

The results showed that the "circular and organization" orientation is the one with the best score in terms of circularity, also expressed in graphic form in Figure 2. This emphasizes the importance of considering the circular economy as part of the corporate organizational strategy and not to relegate it to the sustainability of processes. The company that sets long-term circularity goals manages to be a circular organization over time. Initiatives in this area aim to develop time targets to support the circular vision and mobilize the necessary resources that can help business units prioritize and implement circular initiatives. Recognizing that established internal ways of doing business are likely to impede circular decision-making and at speed and be a barrier for further uptake, it is important to make the circular economy a central element in the ways of working and in the structure of the company, by incorporating the circularity in policies and processes.

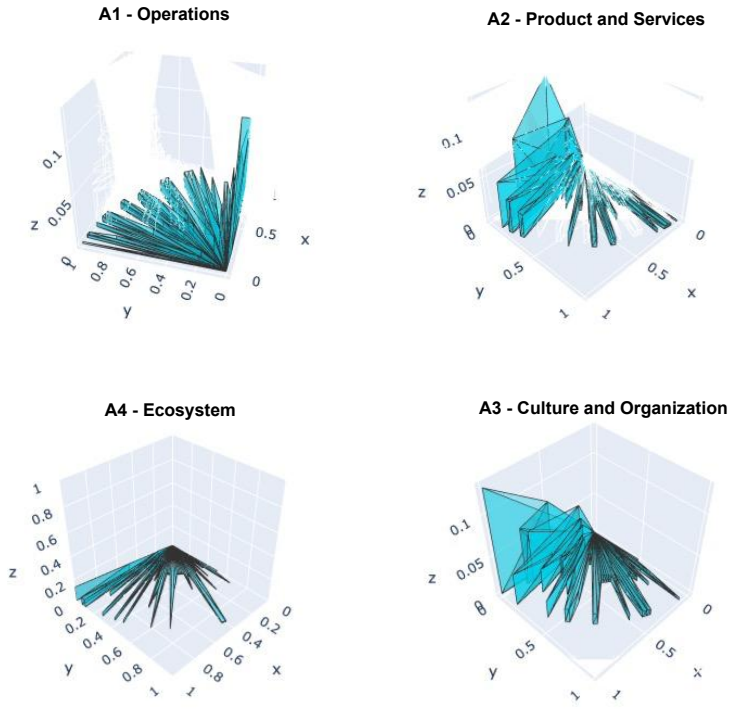

Figure 2 – Graphic representation of the application of the ADAM method to four different circular orientations

6 Conclusion

The need to move from linear to circular production and consumption systems has now been established by both scholars and practitioners. Measuring circularity should, therefore, be a primary objective of all companies intending to apply the circular economy. Otherwise, the efforts made would be untargeted and could lead to non-quantifiable and non-comparable results.

The measurement tool allows the company to understand if, with respect to its business model, by applying the concepts of the circular economy and taking certain actions, it is improving or worsening its performance. Measurement serves to give a contextualized dimension and to inevitably set improvement objectives. To progress successfully, companies must look inward and outward across the value chain and external ecosystem. Organizations need to understand where they fall within the stages of the circular maturity and the extent to which they are implementing circular business models across different dimensions, and thus where they are still lacking. While companies might tend to focus on areas within their immediate control, it is crucial to consider all dimensions holistically due to their interdependencies. The model developed in the study and based on the MCDM method, can be a useful tool to support corporate decisions of agri-food companies on the circular economy, making entrepreneurs aware of their level. This methodology is increasingly being used in management studies (Yalcin et al., 2022).

The applicability of the framework was tested by comparing the circularity of four different circular strategies. The results showed a higher circularity score for "Culture and Organization".

To further improve the demonstrated CE assessment framework, engaged governments, organizations and policymakers are urged to standardize further sets of indicators based on agri-food industries and to involve sectorial expertise. Moreover, to facilitate the evaluation processes, there should be a variety of platforms for data sharing that can be used to create global sets of indicators. This would help expand the capabilities of the framework enabling it to assess circularity on larger scales. Finally, this tool can be useful to channel financial resources towards actions that can effectively enhance circularity.

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Exploring the Outcomes of Sustainability-Oriented Open Innovation: Evidence from the Energy Sector

Armando Calabrese

Department of Enterprise Engineering
University of Rome "Tor Vergata"
Rome, Italy

Roberta Costa*

Department of Enterprise Engineering
University of Rome "Tor Vergata"
Rome, Italy

Arash Haqbin

Department of Enterprise Engineering
University of Rome "Tor Vergata"
Rome, Italy

Luigi Tiburzi

Department of Enterprise Engineering
University of Rome "Tor Vergata"
Rome, Italy

* *Corresponding author*

Abstract

Sustainability-oriented open innovation (SOI) has gained significant attention in recent years. However, there is a lack of evidence on the actual outcomes of this paradigm across enterprises. Thus, this study aims to investigate the implementation of SOI in the energy sector. A thematic analysis (TA) approach was adopted to analyse 64 sustainability reports from energy sector enterprises worldwide. The findings of this study identified five key themes, with three related to the sustainability outcomes of SOI, including "Empowering Business and Increasing Economic Prosperity", "Environmental Stewardship and Conservation", and "Building Sustainable Communities." The remaining two themes focused on how these outcomes were achieved, including "SOI Advancing Measures" and "SOI Facilitating Measures". By providing practical insights, this study aims to bridge the gap in the current body of knowledge on SOI.

Keywords – Open Innovation, Sustainability, Thematic Analysis, Sustainability Reports, Energy

Paper type – Practical Paper

1 Introduction

The indispensable role of the energy sector in shaping every aspect of human existence is undeniable. Indeed, this vital sector serves countless functions, ranging from manufacturing goods to creating emotional connections (DeCotis, 2020). From a financial perspective, the energy sector is also considered a strength for national economies and a driver of economic growth worldwide since it significantly impacts the functioning of other important industries (e.g., construction and transport) (Kowal and Kustra, 2016). Nevertheless, despite all the economic benefits of the energy sector, it generates detrimental environmental and social consequences as well. The ever-increasing emissions of greenhouse gases (Bogdanov et al., 2021) and delivering energy at unaffordable prices (Afshari et al., 2022) demonstrate that the energy sector can be an example of an unsustainable industry (Howell, 2022).

Approved by the United Nations (UN) in 2015, the Agenda for Sustainable Development offers a framework including 17 goals and 169 targets, which aims to accomplish sustainable development globally by the end of 2030 (Wu et al., 2018). Ever since the introduction of Agenda 2030, sustainability has become a prominent feature and a standard practice in every business activity, including those in the energy sector. Since sustainability is of utmost importance and the energy sector is historically unsustainable, enterprises in this sector must continue prioritising sustainability by any means necessary. There are numerous methods to achieve sustainability in the energy sector, such as adopting renewable energy sources (Wang and Zhan, 2019), improving energy efficiency (Meng et al., 2018), and reducing waste (Chong et al., 2016), innovation being at the core of all these methods.

Innovation and sustainability were often regarded as the opposite of each other in the past since industrial innovation was the main cause for using natural resources. However, nowadays sustainability is vital in innovation paths (Bigliardi and Filippelli, 2022). Previous studies also reinforced that the innovation capabilities of enterprises are related to corporate sustainability in a positive and

significant manner (Sempere-Ripoll et al., 2020; Behnam and Cagliano, 2016). Furthermore, according to Kennedy et al. (2017), sustainability and innovation now are regarded as two significant business drivers that when adopted together, have the ability to enhance performance and provide competitive advantage. Nevertheless, because of the ever-increasing uncertainty and complexity of the globalised business environments, it is almost impossible for enterprises to innovate on their own (Payán-Sánchez et al. 2021). Therefore, they need to collaborate with others forging alliances to achieve their sustainability goals as well as, in the long term, for their very survival.

The above-mentioned trend resulted in a paradigm shift in knowledge management and the inception of a novel concept named Open Innovation (OI). OI was first introduced by Chesbrough (2003), and its definition has evolved thenceforth. The very first definition of OI was "*Valuable ideas can come from inside or outside the company and can go to market from inside or outside the company as well. This approach places external ideas and external paths to market on the same level of importance as that reserved for internal ideas and paths*" (Chesbrough, 2003, p. 43). But, more recently, in 2014, Chesbrough suggested an update on the definition of OI according to the concept of business models: "*We define open innovation as a distributed innovation process based on purposively managed knowledge flows across organisational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organisation's business model*" (Chesbrough and Bogers, 2014, p. 17). Broadly, the core concept of OI is the flow of knowledge across the boundaries of organisations (Behnam et al., 2018).

The benefits of OI in addressing sustainability issues have prompted the development of sustainability-oriented open innovation (SOI) (Behnam et al., 2018). Over the past decades, SOI has become an important topic among practitioners and academics. So far, several studies have tried to concentrate on this topic from different perspectives, including identifying its future trends and research trajectories (Bigliardi and Filippelli, 2022; Payán-Sánchez et al., 2021), investigating factors regarding its successful implementation in large organisations (Behnam et al., 2018; Lopes et al., 2017) as well as in small and medium-sized enterprises (SMEs) (Kurniawati et al., 2022). SOI is also adopted in various sectors, including the tourism industry (Del Vecchio et al., 2018), food industry (Troise et al., 2021; Jeong et al., 2020), and even creative industries (Errichiello and Micera, 2018).

In the energy sector, however, SOI can contribute to increase the efficiency of energy (Shinkevich et al., 2019), to create new renewable energy sources (Lacerda and van den Bergh, 2020), and to develop novel transportation systems (Qu and Li, 2019). Nevertheless, despite the increasing emphasis on SOI in enterprises, there is a lack of evidence demonstrating its actual outcomes in the energy sector, as none of the previous studies provided a comprehensive overview of SOI's impact. Therefore, the present study aims to address this research gap by exploring the implementation of SOI in the energy sector. Accordingly, the primary objective of this study is to identify and analyse the outcomes of SOI in the energy sector.

The study aims to achieve the mentioned objective by addressing two research questions. The former is to explore the outcomes of SOI in enterprises operating in the energy sector (RQ1), and the latter is to investigate how these outcomes are achieved (RQ2). To answer the two RQs, this study analysed 64 sustainability reports from enterprises in the energy sector across different countries. The analysis was realised using a combination of computer programming by Python and human critical thinking (See the methodology section). Then, a thematic analysis (TA) approach (Braun and Clarke, 2006) was adopted to determine the themes relevant to the two research questions. This study makes two major contributions: (a) it provides practical insights regarding the sustainability outcomes of the enterprises in the energy sector and how these outcomes were achieved through OI, (b) the findings of this study seek to address a gap in the emerging body of knowledge on SOI.

The remainder of this study is structured as follows. In the next section, the relevant literature on SOI is reviewed. Then, in Section 3, the adopted methodology is explained. Then, in Section 4, findings are provided, and results are discussed. Finally, Section 5 draws the conclusion.

2 Literature Review

2.1 Sustainability-Oriented Open Innovation (SOI)

Herzog (2011) explored two main approaches toward innovation, namely open innovation (OI) and closed innovation (CI). Herzog (2011) also argues that companies must choose the appropriate strategy by considering factors such as their industry, competition, and available resources. CI may benefit some

companies in certain situations, such as when they have proprietary technologies and expertise they want to protect or when they have a solid internal R&D department. Nevertheless, as the uncertainty and complexity of the business environments increased today, the predominance of OI is more established in companies (Bigliardi et al., 2021), especially to address sustainability challenges (Bigliardi and Filippelli, 2022; Payán-Sánchez et al., 2021) and radical innovation (Kennedy et al., 2017).

As previously described, OI is a novel approach to managing knowledge that entails innovation procedures that are distinguished by a willingness to engage with the external environment. This approach contrasts with the traditional CI model that has been embraced by companies in the past. Moreover, as the notion of OI gained prominence in the academic literature, it was referred to using various terms that overlap, although the nuances of their meanings may differ slightly, such as co-creation (Frow et al., 2015), crowdsourcing (Majchrzak and Malhotra, 2013), and user innovation (von Hippel and Euchner, 2013). In addition to the different notions of OI, two distinct forms can be identified: inside-out (inbound) OI and outside-in (outbound) OI. According to Chesbrough (2012), the inside-out process entails converting internally generated innovations into external business opportunities through licensing, spin-offs, patent sales, and commercial joint ventures. The second process, outside-in, facilitates the exploitation of externally generated innovations from traditional suppliers and new alternative sources.

Furthermore, in the sustainability context, it is also apparent that diverse terminologies have been employed to explore the potential of (open) innovation in promoting sustainable development. Fussler and James (1996) were the pioneers in SOI literature. They introduced the concept of eco-innovation, which pertains to creating and implementing novel products, processes, services, and business models that support environmental protection and sustainability. Eco-innovation involves incorporating ecological considerations at every stage of the innovation process. Other comparable phrases have arisen, such as environmental innovation (Dias Angelo et al., 2012), green innovation (Schiederig et al., 2012), and sustainable innovations (Bos-Brouwers, 2010), all of which aim to capture the essence of innovation for sustainable development. Some studies have concentrated specifically on environmental concerns, mainly regarding new product development, resulting in the term environmental or green product development, which has been extensively investigated in prior research (de

Medeiros et al., 2022; Khan et al., 2021). However, the present study employs the term "Sustainability-Oriented Open Innovation" to examine its outcomes based on the three pillars of sustainability (environmental, social, and economic) (Purvis et al., 2019). This way, the findings can be more comprehensive according to the Agenda for Sustainable Development. This term is also more commonly used in the innovation management literature (Behnam et al., 2018).

2.2 Sustainability-Oriented Open Innovation (SOI) in the Energy Sector

There is a dearth of research specifically mentioning SOI within the energy sector. Still, several studies in this sector have explored the concept of OI and considered sustainability simultaneously.

Arnold and Barth (2012) investigated how OI can increase energy efficiency in urban energy systems through a real case study. The findings of this study provided insights into how OI tools can be beneficial in driving innovation and sustainability in urban energy systems. Although various businesses employ OI tools like innovation workshops or ideas competitions to discover and create novel designs and products, there is limited familiarity with using such methods for energy efficiency concepts. In the same vein, Ramirez-Portilla et al. (2013) explored the potential of OI practices to improve industrial energy efficiency by investigating case studies of companies that have implemented OI to achieve energy efficiency gains. Results suggested that an inbound approach toward OI can be more advantageous for decreasing technology-related barriers to energy efficiency. Also, in another study, Ramírez-Portilla et al. (2014) investigated the relationship between indicators of energy efficiency and OI practices in SMEs. The findings showed inbound open innovation is quite used to improve energy efficiency, while outbound open innovation is not a common and, therefore, relevant practice. There are also other studies by Jalal et al. (2019) and Shinkevich et al. (2019), both of which focused on the role of OI in energy efficiency initiatives. Closely related to the energy efficiency domain, Stanisławski (2022) explored the characteristics of OI practices in the rational use of energy resources to achieve sustainable development goals (SDGs) amongst SMEs. The survey results in this study revealed the key factors that drive the adoption of OI practices and their impact on innovation and sustainability performance.

Furthermore, other studies on OI pursue renewable energy sources as a sustainable outcome. Analysing the existing literature, González et al. (2012)

explored OI practices' adoption, including collaboration and co-creation with suppliers, customers, and other stakeholders, in developing wind energy supply chains. This study showed that OI could contribute to developing the wind energy supply chain by increasing knowledge sharing and reducing costs. Also, Chiaroni et al. (2015) analysed the implementation process of OI practices in a specific renewable energy project and assessed their impacts on innovation and project outcomes. This study identified key success factors and challenges of OI implementation in this context, including the need for effective communication and collaboration with external partners.

Moreover, de Paulo and Porto (2017) explored the development of solar energy technologies through OI by reviewing the available literature on this subject and adopting a social network analysis (SNA) approach. This paper determined indirect evidence of OI regarding solar energy development since the literature on solar energy technologies did not explicitly mention it. In another study, Lacerda and van den Bergh (2020) investigated the knowledge-sourcing strategies for innovation in two technology fields of the renewable energy sector: solar and wind power. According to the findings of this paper, solar power innovation benefits from a broad search strategy drawing on a large number of external knowledge sources. In contrast, wind power innovation tends to thrive intensively using a more limited number of external sources. Finally, Alam and Ansari (2020) explored the role of OI in decreasing the cost of wind energy projects in energy-poor countries. Through case studies of wind energy start-ups, they explored the characteristics and benefits of OI ecosystems. They concluded that these start-ups could leverage OI ecosystems to reduce costs and improve competitiveness.

In addition to focusing on renewable energy sources, Qu and Li (2019) also concentrated on new energy vehicles as a sustainability outcome of OI. They used case studies of firms active in the new energy vehicle industry to analyse leveraged demand-side OI. They proposed industrial policies, including the need for policies that promote collaboration and knowledge sharing among firms and other stakeholders. Table 1 summarises previous studies that have explored the concept of SOI in the energy sector.

Table 1. Previous Studies on SOI in the Energy Sector

Sustainability Outcome	Study	Objective
Energy Efficiency Initiatives	Arnold and Barth (2012)	Investigating the role of OI in increasing energy efficiency
	Ramirez-Portilla et al. (2013)	Exploring the role of OI practices in improving energy efficiency
	Ramírez-Portilla et al. (2014)	Investigating the relationship between energy efficiency indicators and OI practices
	Jalal et al. (2019)	Investigating the role of OI on energy efficiency initiatives
	Shinkevich et al. (2019)	Exploring the role of OI on energy efficiency
Energy Resources Conservation	Stanisławski (2022)	Exploring the characteristics of OI practices in the rational use of energy resources
Renewable Energy Promotion	González et al. (2012)	Exploring the adoption of OI practices in the development of wind energy supply chains
	Chiaroni et al. (2015)	Analysing the implementation process of OI practices in renewable energy project
	de Paulo and Porto (2017)	Exploring the development of solar energy technologies through OI
	Lacerda and van den Bergh (2020)	Investigating the knowledge sourcing strategies for innovation in the renewable energy sector
	Alam and Ansari (2020)	Exploring the role of OI in decreasing the cost of wind energy projects
New Transportation Systems Development	Qu and Li (2019)	Analysing leveraged demand-side OI

Table 1 presents a summary of previous studies' findings and highlights four possible outcomes of SOI in the energy sector: energy efficiency initiatives, conservation of energy resources, promotion of renewable energy, and development of new transportation systems. However, these outcomes have predominantly focused on the environmental aspect of sustainability, with little attention given to the social and economic dimensions. Despite existing research in this field, no comprehensive study has investigated the outcomes of SOI in the energy sector based on all three dimensions of sustainability simultaneously. Additionally, no studies have explored the measures employed to achieve these outcomes. As such, this study aims to address this research gap.

3 Methodology

As stated earlier, the main aim of this study is to investigate the implementation of SOI in the energy sector. A qualitative research approach was used to achieve this goal, which involved four steps, as shown in Figure 1. The necessary data for analysis were sourced from the Global Reporting Initiative (GRI) Sustainability Disclosure Database, that until December 2020 was open and accessible to the public. The database contained sustainability reports from companies worldwide, including GRI-based and non-GRI-based. The sampled reports had to meet four main criteria. Specifically, they had to be written in English, comply with the GRI standard, be verified by third parties, and be related to 2018. By applying these selection criteria, the data become more consistent, leading to an enhanced quality of analysis. Ultimately, 64 GRI-based sustainability reports from the energy sector companies were selected for the study. The subsequent paragraphs provide a comprehensive overview of each step.

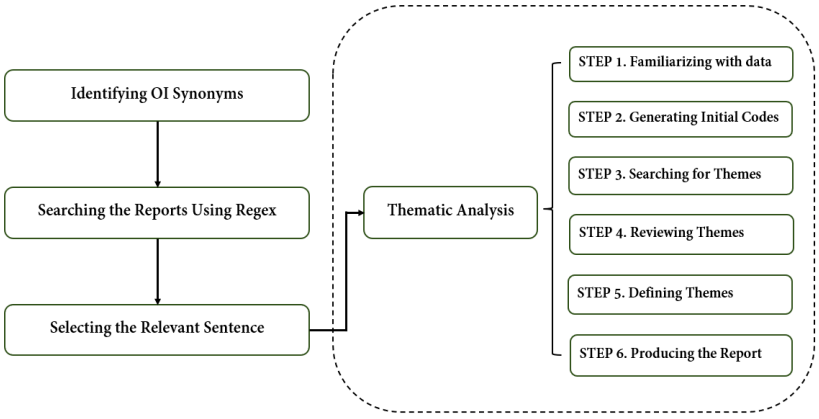

Figure 1. Research Process

STEP 1. Identifying OI Synonyms

As previously mentioned, the existing literature on OI comprises various overlapping terminologies, each with its subtle nuances in meaning. To avoid overlooking any relevant reference to OI in sustainability reports, all possible synonyms of OI should be included. To accomplish this, a search of the Scopus database was conducted using the keyword "Open Innovation" combined with "Review".. Then, to ensure that all relevant references to OI in sustainability

reports were captured, 30 synonyms were selected based on the 45 literature reviews found.

STEP 2. Searching the Reports Using Regular Expressions

To automatically detect within sustainability reports the various OI synonyms identified in the previous step, it was necessary to account for their different phrasings. To achieve this, regular expressions (regexes) were employed. Regexes are snippets of code used in computational analysis to identify patterns within text strings. For instance, to recognise the term "Start Up" in the reports, the following regex was utilised with Python's re library:

(r"start[\s\W]?up|start[\s\W]?\W\sup", re.IGNORECASE)

This regex identifies all variations of the term, such as "startup" , "Start-Up" , and "Start Up" , among others. It is essential to apply this step because the same OI synonym can be expressed in different ways in various reports while maintaining the same meaning. Failure to address this issue can negatively impact subsequent analysis. The same procedure was applied to identify other OI synonyms. Upon request, the corresponding author can provide the complete list of regexes and the Python code used in the analysis.

STEP 3. Selecting the Relevant sentence

Although all of the identified synonyms have a common meaning of OI, not all of the selected sentences necessarily relate to OI. Hence, an additional screening process was conducted, according to the OI definitions established by Chesbrough (2003) and Chesbrough and Bogers (2014). This screening process was based on human perception to verify that the selected sentences were relevant to OI. The outcomes of this step serve as the input for the main analysis, which is explained in the subsequent step.

STEP 4. Thematic Analysis (TA)

The analysis of the sustainability reports was conducted using the TA approach proposed by Braun and Clarke (2006). TA is a qualitative research method used to identify, analyse, and report patterns or themes within data in various fields. This qualitative method is flexible and iterative and can be tailored to suit the research question, data type, and analytical approach. Braun and Clarke (2006) outline six phases of TA:

1. familiarising yourself with the data: the researcher reads and re-reads the data repeatedly to obtain a comprehensive understanding of the content;
2. generating initial codes: the researcher recognises intriguing aspects of the data that may be germane to the research question and assigns them a short phrase;
3. searching for themes: the researcher investigates the preliminary codes to determine patterns, resemblances, and disparities that can be combined into possible themes;
4. reviewing themes: the researcher evaluates the themes to ensure they are consistent, meaningful, and accurately depict the data. The researcher may also modify or merge themes, if necessary;
5. defining themes: the researcher defines each theme, providing a clear description of its significance and supporting evidence from the data. Each theme is also given a name that encapsulates its essence,
6. producing the report: the researcher documents the findings, utilising quotations and examples from the data to clarify the themes and their connotation.

Furthermore, since demonstrating rigour in qualitative research relies heavily on exhibiting precisely how the researcher progressed from unprocessed data to final themes (Tracy, 2010), the TA utilised the data structure proposed by Gioia et al. (2013). According to Gioia et al. (2013), a data structure is the favoured way to capture the evolution of themes from primary coding to aggregated or theoretical themes. The data structure not only facilitates the arrangement of data into a logical visual aid, but also delivers a graphic representation of the theme development process (Mishra and Dey, 2022).

4 Results and Discussion

The concept of OI has gained significant attention in recent years as a means of increasing competitiveness (Gao et al., 2020; Huizingh, 2011), particularly for addressing sustainability challenges (SOI) (Bigliardi and Filippelli, 2022). However, an analysis of sustainability reports from 64 energy sector enterprises worldwide suggests that OI adoption is lacking, as only 28 companies mentioned OI or its synonyms in their sustainability reports. This result suggests that most energy companies are not using OI to enhance their sustainability efforts. Additionally,

the analysis reveals that OI is more prevalent among large, privately owned energy companies, with only one instance of OI mentioned by an SME. However, this may be due to the challenges that SMEs face when initiating sustainability reporting (Arena and Azzone, 2012). Geographically, 18 of the companies mentioning OI were located in Europe, followed by six in Asia, three in Oceania, and one in North America. This result indicates significant regional differences in the awareness and adoption of OI practices within the energy sector. This trend is similar to other emerging paradigms, such as Industry 4.0 (Calabrese et al., 2023).

As outlined in the methodology section, TA (Braun and Clarke, 2006) was used to address the two research questions. Also, according to the data structure mentioned in the Gioia method (Gioia et al., 2013), relevant sentences related to OI were selected, and 1st order concepts were extracted from each sentence. These concepts were then aggregated to develop 2nd order themes, which were grouped to form aggregate dimensions or main themes. To clarify this process, Table 2 and Table 3 provide examples. To ensure transparency, the corresponding author can provide the data structure for all the sentences upon request.

Table 2. Identifying 1st Order Concepts through OI Sentences

OI Synonym	Sentence	1st Order Concept
Venture	Through our venture capital arm, Bangchak Initiative and Innovation Center (biic), we developed the Green Community Energy Management System (GEMS) to leverage our investments in renewable energy and lithium mining to support the growth of electric vehicles and lithium-ion battery (Bangchak Petroleum, 2019, p. 4).	• Innovating through venture capital arm • Supporting green energy management • Developing renewable energy • Developing lithium mining • Supporting electric transportation • Investing in lithium-ion battery
Start-Up	Shell Foundation has provided support to start-up business Aceleron which is exploring, among other things, how to use waste car batteries in the off-grid sector as storage or a power source (Shell, 2019, p.60).	• Supporting start-ups • Reusing waste car batteries
Co-Creation	By co-creating and collaborating with our ecosystem, we are able to significantly decrease the span of time from innovation to market, and to respond faster to new market needs with the development of holistic solutions (Wärtsilä Corporation, 2019, p. 34).	• Co-creating with ecosystem • Decreasing the span of time from innovation to market • Responding faster to new market needs

Table 3. Main Themes Development Process

1st Order Concept	2nd Order Themes	Aggregate Dimensions (Main Themes)
• Developing novel recyclable products • Supporting and Encouraging plastic waste reduction • focusing on reusing waste car batteries	Promoting Circular Economy Concept	Environmental Stewardship and Conservation
• Developing co-creation events to solve industry challenges • Co-creating new products and solutions • Promoting co-creation activities for innovation	Advancing Open Innovation by Co-Creation	SOI Advancing Measures

The TA of sustainability reports revealed five main themes, three of which relate to the outcomes of SOI (RQ1), while the remaining two address how these outcomes were achieved (RQ2). The three main themes developed to answer (RQ1) are "Empowering Business and Increasing Economic Prosperity", "Environmental Stewardship and Conservation", and "Building Sustainable Communities". The two main themes developed to address (RQ2) are "SOI Advancing Measures" and "SOI Facilitating Measures". Figure 2 depicts the sub-themes for each theme.

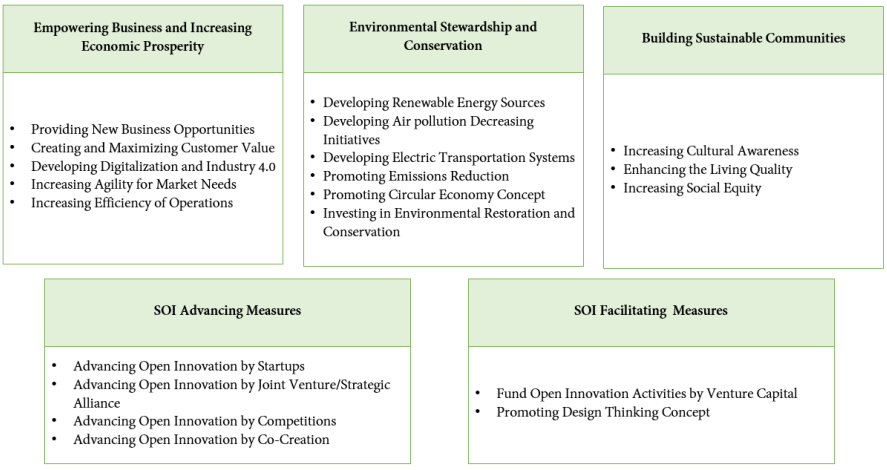

Figure 2. Final Themes of SOI in the Energy Sector

As shown in Figure 2, "Empowering Business and Increasing Economic Prosperity" consists of five sub-themes, including "Providing New Business Opportunities", "Creating and Maximising Customer Value", "Developing Digitalization and Industry 4.0", "Increasing Agility for Market Needs", and "Increasing Efficiency of Operations". These sub-themes include various concepts aimed at empowering businesses and increasing economic prosperity through OI, which is identical to the outcomes of conventional OI (compared to sustainability-oriented ones) (Rauter et al., 2019). For instance, in the sub-theme of "Developing Digitalization and Industry 4.0", the focus is on promoting digitisation (e.g., for the health and safety of human resources) and using technology such as digital twins and cyber security to generate new S-curves. Moreover, some of the sub-themes, including "Creating and Maximising Customer Value" which aims to identify potential customer values and maximise the value of new products and solutions, or "Increasing the Efficiency of Operations" which concentrates on developing novel operational tools and solutions, are identified in other novel revolutions like industry 4.0 (Calabrese et al., 2023)

As one of the most important themes for the outcomes of SOI, "Environmental Stewardship and Conservation" includes six sub-themes, each addressing different aspects of environmental protection and sustainability. These sub-themes are "Developing Renewable Energy Sources", "Developing Air Pollution Decreasing Initiatives", "Developing Electric Transportation Systems", "Promoting Emissions Reduction", "Promoting Circular Economy Concept", and "Investing in Environmental Restoration and Conservation". These sub-themes aim to promote sustainability and a greener future. Amongst them, the sub-theme of "Developing Renewable Energy Sources" was paid the most attention in the previous literature (Alam and Ansari, 2020; Lacerda and van den Bergh, 2020; de Paulo and Porto, 2017). Of course, other subthemes, such as "Developing Electric Transportation Systems" and "Investing in Environmental Restoration and Conservation" were also mentioned in the previous studies (Stanisławski, 2022; Qu and Li, 2019)

Furthermore, only three sub-themes related to "Building Sustainable Communities", associated with the social SDG11 (Sustainable cities and communities) , were identified. This result demonstrates that social outcomes and social enterprises have not received significant attention from academics and practitioners (Harsanto et al., 2022). The three identified sub-themes in the social theme include "Increasing Cultural Awareness", "Enhancing the Living Quality", and "Increasing Social Equity". "Increasing Cultural Awareness" focuses on

promoting the responsible use and conservation of natural resources and community well-being. Also, "Enhancing the Living Quality" aims to improve the quality of life in urban areas by developing new lighting solutions, implementing smart city technologies, and improving the quality of drinking water. Moreover, "Increasing Social Equity" addresses inequality by supporting local and small-scale producers and providing energy access to low-income communities.

On the other hand, in response to the second research question, two main themes were determined: SOI Advancing Measures and SOI Facilitating Measures. Advancing measures generally refer to actions that actively move SOI objectives toward completion or achievement. These measures are typically more direct and specific. Facilitating measures, however, refer to activities that make it easier to achieve SOI objectives, and they may not directly contribute to the achievement of the objectives. According to the findings of this study, there are four "SOI Advancing Measures", i.e., "Start-ups", "Joint Venture/Strategic Alliance", "Competitions", and "Co-Creation". "SOI Facilitating Measures" consist of two sub-themes. The first sub-theme, "Fund Open Innovation Activities by Venture Capital", emphasises the importance of venture capital in funding open innovation activities and supporting the growth of start-ups and new ventures. The second sub-theme, "Promoting Design Thinking Concept", highlights the significance of design thinking in facilitating OI by promoting user-centricity and collaboration.

It is worth noting that this study has two significant contributions. Firstly, it provides practical insights into how enterprises in the energy sector achieve the outcomes of SOI and how these outcomes are achieved. Secondly, the study aims to fill a gap in the current body of knowledge on SOI. However, the study has limitations to consider. Specifically, the findings are only based on the analysis of 64 sustainability reports from the energy sector in 2019. Future studies can improve upon this by examining more sustainability reports from the energy sector, adding additional years to compare themes, which could be particularly valuable in light of the COVID-19 pandemic and the Russia-Ukraine conflict. Alternatively, future researchers can broaden their scope to include other sectors.

5 Conclusions

In the past, innovation and sustainability were viewed as conflicting concepts. However, sustainability has now become an essential component of innovation. Nevertheless, due to the complex and uncertain global business environment, enterprises cannot innovate alone, and they must form alliances to achieve their sustainability goals and ensure their survival. This has resulted in a paradigm shift, leading to the emergence of SOI, which has gained attention in academia and practice in all industries and sectors. The primary objective of this study was to explore the implementation of SOI in the energy sector. To achieve this, the study analysed 64 sustainability reports from energy enterprises worldwide, using a combination of Python programming and human critical thinking. The study employed TA to identify relevant themes. The findings of this study revealed five main themes, three of which relate to the outcomes of SOI, while the remaining two address how these outcomes were achieved. The themes developed to determine the outcomes of SOI are "Empowering Business and Increasing Economic Prosperity", "Environmental Stewardship and Conservation", and "Building Sustainable Communities". On the other hand, the themes developed to address how the outcomes of SOI are achieved are "SOI Advancing Measures" and "SOI Facilitating Measures". By offering practical insights regarding this novel paradigm, the study aimed to address the gap in the current body of knowledge on SOI.

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Sustainability versus Digitalisation in the Public Water Sector: Knowledge-Driven Insight Taken from an Evolutionary Digitalisation Project in a German Public Hybrid Water Association

Markus Vogl*

Markus Vogl {Business & Data Science}
Adelheidstraße 51
65185 Wiesbaden (DE)

Holger Scheffler

Wasserverband Kinzig
Kurt-Schuhmacher-Straße 8
60311 Frankfurt am Main (DE)

* *Corresponding author*

Abstract

This paper analyses the tension field between digitalisation, sustainability and knowledge management in the water sector, particularly, in the context of climate change and water stress. The importance of sustainable hybrid drinking water supply and simultaneous flood protection is outlined by a practical case study within a German water association with a total volume of around 100 Mio. EUR. An ongoing evolutionary digitalisation project is presented and research propositions are stated, which are centred on the questions of deployment of sustainable critical success factors (CSFs) based AI-solutions paired with knowledge management systems (KMS) in the context of climate change and water stress. The application of CSFs and the creation of digital and rational decision-making models based on KMS are elaborated on. Additionally, it is elucidated, whether digitalisation, knowledge and sustainability are to be seen as CSFs in themselves, which thereinafter is confirmed. Finally, the possibility of integrating Kingdon's multiple stream model into an AI-based KMS to provide management decision support is explained. In conclusion, knowledge is seen as a binding key for achieving a sustainable digitalisation strategy within a critical infrastructure organisation.

Keywords – flood protection; drinking water supply; data-driven knowledge management; evolutionary digitalisation IT project; sustainable public water sector

Paper type – Practical Paper

1 Introduction

Following Ntuli and Abu-Mahfouz (2016) and Debele et al. (2019), water scarcity and water stress issues have rendered themselves to be an imminent threat to the global society. Simultaneously, climate-change induces stronger and more frequently occurring natural hazards, which will threaten the totality of human existence without human intervention. Future global water demand is projected to exceed the availability of existing water resources by approx. 40%. (Hake et al., 2016). Therefore, by 2040, various countries in Europe will face drastic water stress, i.e., low groundwater and river water levels, heavy rainfall, or flooding, which may affect supply security as well as water transport routes and, thus, will cause (critical) system failures (Scheffler, 2020; Hake et al., 2016). Guerreiro et al. (2018) similarly demonstrate these increasing trends of flooding in European cities through the elaboration on the influence of floods in over 570 cities in Europe. One of the most recent, drastic and largest examples of flooding and its consequences can be seen in the German Ahrtal-catastrophe 2021, with 134 dead and damages ranging around 33 Bn. EUR (Scheffler, 2022). Referring to drinking water security, Mondejar et al. (2021), state that existing variability in drinking water quality represents a morbid threat to the broad population and encourages smart city solutions to strive for the highest possible quality of water for all respective citizens.

Therefore, this paper, which is based on a case study, addresses any person, entity or organisation concerned with the adaptation of digitalisation, sustainability and knowledge management in the context of drinking water supply and flood protection. In the following, the paper elaborates on the scientific and practical implications of these three main focal points for practitioners and knowledge researchers in the domain:

1. How to implement holistic or system-wide climate-proof and sustainable drinking water supply through hybrid solutions, which are applied to classic flood protection facilities (e.g. dams)?
2. How to realise projects faster through the application of identified critical success factors (CSFs) at the political and planning level?
3. In which frame is the creation of digital and rational decision support models based on a synergy of knowledge management systems (KMS) and artificial intelligence (AI) solutions achievable?

The paper is based upon the results of a larger research study, which started in 2010 as a case study in a German water association, encompassing six research papers; its scientific insights are directly and practically implemented. The concerned association incorporates one of Europe's exemplary hybrid solution pilot-projects for technical flood protection and drinking water supply and the planning of a (semi-autarkic) surface water plant including a multi-barrier system (MBS) with a total volume of around 65 Mio. EUR. In the course of the research study, Scheffler (2022) and Scheffler and Vogl (2022) determined the successful implementation of a knowledge management system (KMS) based on empirically derived CSFs. Moreover, an evolutionary digitalisation project has been initiated within the association, which serves the purpose of engaging in the human-water-data nexus (see Poch et al., 2020) as well as exploiting the existing, yet, not utilised data-pools to further optimise the existing KMS and enhance predictive disaster management processes, among others. Further intention is to secure the flood protection systems as well as to guarantee the highest drinking water quality from a technical and economical point of view. To explicate the latter supposition further, the past research study enables the knowledge-driven planning on a political and policy level, while the ongoing evolutionary digitalisation project reflects these insights on an organisational and technical process level.

Thus, to be more detailed, the ultimate goal of the project is to enable an integration of Kingdon's multiple stream model (see A.1) into an AI based KMS, which is expected to serve as a management decision support system in the future (Appio et al., 2021; Ardito et al., 2018; Herweg, 2015). The combination of AI and policy models in the given context is currently seen as a gap in the existing literature. The Kingdon's multiple stream model represents an analysis model, which is distinguished into three streams, namely, the problem stream (i.e. delta between current and intended state), the political stream (i.e. content aspect of the political dimension) and the policy streams (i.e. processual aspect of the political dimension) (Herweg, 2015). Given a corresponding degree of maturity of the streams, overlaps arise that with the support of policy entrepreneurs, create a "policy window" and, thus, elevate the referring subject to the decision-making level of the political agenda (Herweg, 2015). Concerning AI-based solutions, that are capable of gaining insights from big data, the aim is to provide decision supports for the political and policy processes, leading to integrated data and

knowledge-based political decisions to cope with the challenges of climate change in the water sector.

Hence, following current research, AI is proposed to enable transfers between passive data into knowledge-driven decision-making systems (Al Aani et al., 2019). With this a pure rational and fact-based identification and exploitation of the "policy window" is expected to be possible within an acceptable period.

The denoted surface water plant (see A.2) represents a part of the mentioned case study and is one result of the successful practical implementation of the derived CSFs on a policy level (Scheffler, 2020). The surface water plant is part of a hybrid solution, which enables to repurpose and enhance existing dams (as representations of MBS) for drinking water supply, energy generation, low-water enrichment and other tasks. As previously mentioned, climate change will lead to severe event chains effecting the water sector in general (Scheffler & Vogl, 2022; Debele et al., 2019). These cause-effect relationships result from the increase in heavy rainfall and flood events in interaction with longer and more severe drought periods (Scheffler & Vogl, 2022). In addition, future snowmelt will be absent or more irregular, leading to a negative effect in groundwater recharge in the years ahead (Scheffler & Vogl, 2022). Furthermore, hotter summers with severe droughts are predicted, leading to parched soils on which heavy rainfall events then run off on the surface (Olmstead, 2014). Moreover, possible damages may occur and seepage with groundwater level rise fails to happen (Olmstead, 2014). This negative combination of too little precipitation, declining groundwater levels, and extreme heavy rainfall results in a continuous stress test for the water sector (Scheffler & Vogl, 2022).

The evolutionary digitalisation project has been initiated to face climate change and enable the according water association with the technological capabilities to implement, adapt and exploit the possibilities granted by real-time big data, data science, AI and other technological conceptions with the goal to provide efficient flood protection and secure drinking water supply in a hybrid setting. To enable the association with the latter capabilities, it has been deemed unavoidable to restructure the complete organisational structure, business processes and underlying informational architecture as well as the technical infrastructure. Thereinafter, it is intended to implement various layers of technical applications, deploying data scientific and AI-driven algorithms to aid in the given task of flood protection and drinking water supply. In particular, as already denoted, the creation of an AI-driven KMS for management decision support is intended.

Nevertheless, as viable core member of the critical infrastructure of Germany, the association has to comply with various regulations and other dimensions in parallel to ensure a legally compliant and a state-of-the-art project realisation (see A.3). Nonetheless, the remainder of the paper will focus on the tension field between digitalisation, sustainability and KMS, while aiming to close the stated research gaps.

2 Research Presuppositions

Based on the introductory elucidated insights and aims of the evolutionary digitalisation project, several research propositions can be derived, which are the basis of this paper. Scheffler (2022) states that the multiple stream model of Kingdon reveals itself in practical policy matters successfully, while "policy windows" opened after the Ahrtal catastrophe. Furthermore, the derived CSFs have been practically applied as binding element in the context of the "policy window" to enable the planning of said surface water plant, translating theory into practical policy politics. Within the evolutionary digitalisation project, these insights are required to be implemented on an operative or organisational level. Thereto, the first research presupposition can be stated as the question, whether it is possible based on the denoted CSFs in the context of climate change induced water stress to determine and implement an AI-based KMS to support management decisions, which also respects the dimensions of sustainability and digitalisation at the same time. Building upon this supposition, the second research conjecture arises, namely, whether in the context of sustainability and digitalisation, AI and related applications as well as knowledge in itself are to be treated as CSFs. Finally, it must be clarified if such an AI-based KMS decision model can be trusted, is reliable and can be scaled and standardised as a template for future projects. All these supposition are additionally to be set into perspective of resilience and ethics, since the water sector is part of the critical infrastructure and decisions based on AI need to be ethically validated since human lives are directly at stake with its decisions.

3 Scientific Insights

3.1 Digitalisation

The global economy is shifting through an extended period of digitalisation, encircling the majority of daily live activities, which are highly dependent on innovation and contemporary technology (Mondejar et al., 2021). Furthermore, digitalised applications are inherently interwoven in socio-economic, environmental, sustainable and climate research activities among productive or information systems (Balogun et al., 2020; Ceipek et al., 2020). This holistic perspective states digitalisation as advantageous in terms of solving problems such as biodiversity and climate change (Mondejar et al., 2021). To define digitalisation, Brenner and Hartl (2021) are regarded, who contrastingly state digitisation as the process of conversion between physical and analogous information into its digital counterpart, which then can be processed, stored or manipulated (Dougherty & Dunne, 2012; Loebbecke & Picot, 2015). Digitisation in itself is driven by technological progression, focussed on enhancing efficiency through process automatization (e.g. by means of organisational reconstruction) (Brenner & Hartl, 2021). Notwithstanding, digitalisation centres around the disposition of information and communication technologies to transform a given organisation's business model (Li et al., 2018; Ramaswamy & Ozcan, 2016). However, with the presented project, a unison between digitisation and digitalisation is required, thus, digitalisation and a restructuring is conducted simultaneously.

Notwithstanding, the aim of AI-based KMS is not a singularity within the academic literature and in terms of digitalisation, several publications build the foundation of the presented insights. Following Metta et al. (2022) assess the contribution of digitalisation and its responsible usage as case study with a socio-cyber-physical system concept applied to US agricultural deployments framed by the context of innovation and responsible research. Metta et al. (2022) state the elucidation of relationships between digital and sustainable development intensions, optimising assessments and avoid emotionally biased dichotomies related to digitalisation by specifying effects and referring trade-offs successfully. However, drawbacks are stated in terms of complexity of multiple topic dimensions, leading to the requirement of conceptual and operational knowledge as basis of responsible digitalisation evaluations (Metta et al., 2022).

The results are additionally cornered by stated concerns about the socio-technological and environmental requirements, direct and side effects of given digital transformations at a micro- or macro level of social inequalities, climate justice and ethical debates (Metta et al., 2022). Moreover, top-down frameworks and pre-defined quantitative metrics can be negatively affect reflexivity and limit the understanding gathered of denoted interrelations between digitalisation and stakeholders within a sustainability dimension, considered a gap as of now (Metta et al., 2022).

Referring to more practical applications, Du et al. (2022) state the possibility of sustainable management of global water resources as critical to achieve productivity and maintaining ecological security, thus, provide an exploration of virtual water trade, elevating water sustainability, to cope with water scarcity, which renders itself visible as a global risk. The resulting water conservation is deemed to enable national economies and inherent sectors to adapt to climate change more efficiently (Du et al., 2022). To elaborate on the denoted possibility, Du et al. (2022) propose an integrated framework of meta-coupling, including human-nature interactions across space- within a place (intra-coupling), between adjacent places (peri-coupling) and between distant places (tele-coupling), validated as advantageous tool with unique systematic viewpoint to depict human interactions. Furthermore, by introduction of feedbacks and trade-offs of multiple systems, the framework is able to improve policy effectiveness in terms of global trade, knowledge dissemination and others capable to evaluate water sustainability over various systems (e.g. groundwater systems) (Du et al., 2022).

Analogously to the human-water-data nexus depicted in Poch et al. (2020), Bhandari et al. (2023) suggest transformations of water utilities as cyber-physical-human systems with increasing interconnections and interdependencies between physical assets, cyber systems and human interactions. The provided review includes existing methodologies to model the changes and arising knowledge gaps (Bhandari et al., 2023). Furthermore, the scientific consensus states that technological, social, environmental, economic, regulatory and operational factors influence water utilities, which is reflected in the evolutionary digitalisation project from a practical point of view (see A.3) (Bhandari et al., 2023). Moreover, challenges emerge in terms of legacy IT systems, outdated infrastructure, environmental influence and sustainability, data management and analytics as well as cyber security knowledge and regulatory compliance, among others (Bhandari et al., 2023).

A notable gap exists in the identification and evaluation of multiple impact factors, their interconnections and evolving risks for decision-making, which, however, has been addressed in the meanwhile in Scheffler (2022) by stated CSFs. Finally, the stated gap encompasses topics such as strategic planning for technological adoption and data management, which is covered by the presented digitalisation project (see A.3).

Since one aim of the digitalisation project is to enable an AI-based KMS decision model, it is relevant to elaborate on the state-of-the-art in context of AI and water management applications. Following Fu et al. (2022), propose a review of deep learning applications within the water sector for e.g. planning, forecasting and assessments as well as monitoring of flooding. As a result, Fu et al. (2022) state that the applicability of AI within the water sector is still in an early stage, as most studies applied benchmark networks, synthetic data, laboratory or pilot systems to evaluate performance of deep learning applications with no practical adoption being reported.

Hence, the application of AI within the presented digitalisation project will pioneer the implementation of AI-based solutions based on real-time water monitoring data within a real-world scenario. Fu et al. (2022) further denote five critical challenges, namely, data privacy, algorithmic development, explainability, trustworthiness and multi-agent as well as digital twin systems, which are seen as key areas to advance frontiers of research and practical applications in the water sector. The successful implementation of AI within the water sector is seen as the key driver of urban water systems towards autonomy and high intelligence (Fu et al., 2022).

Building upon AI deployment, AI itself necessitates big data lakes to be efficiently implemented and trained, thus, an efficient water management system requires thousands of constraint devices (e.g. sensors) to be deployed across the water distribution network to enable almost real-time monitoring and control of water grid components (Ntuli & Abu-Mahfouz, 2016). Given this presupposition, a high level of security at both the device and network level is critical to the operation of such systems (Ntuli & Abu-Mahfouz, 2016). It has become imminent that a technological world, elevated and enhanced by information and communication systems, has become crucial in terms of sustainable development and digitalisation, in particular, water management is such a targeted area (e.g. leakage detection, dynamical optimisation of performance), however, is simultaneously prone to cyber-attacks (Ntuli & Abu-Mahfouz, 2016).

Notwithstanding, these algorithms emphasise the requirement of in-depth future research activities to enable (critical infrastructure) organisations to cope with cyber threats by network monitoring at runtime, avoiding false alarms or keeping the algorithms updated in the context of novel cyber threat technologies (Cascavilla et al., 2021). The attempt to prevent cybercrimes requires the according organisations to yield a better understanding of the functioning and nature of the cyberspace and data, among other aspects of expertise in computer sciences (Maimon & Louderback, 2019). Henceforth, the digitalisation project presented in this paper is given the crucial challenge of cybersecurity, since a drinking water and flood protection organisation must neither collapse nor cease functioning under any given terroristic nor cyber-attack of any kind. Please note that due to classified security details, no details of the practical nor academic implementation of the cybersecurity aspect are granted.

On the other hand, regarding the drawbacks of digitalisation, following Ågerfalk et al. (2022), debate that digital technologies can also be deemed harmful for the environment, which contrasts the preservation intention of these technologies and propose pathways towards potential green information system solutions. More specifically, a biological baseline has to be established to evaluate the influence of climate change and other impacts on the global biodiversity (Hedrick et al., 2020). Further, following Lopez et al. (2016), point out that the sole existence of data itself is not a guarantee for best practices referring to the dimension of data quality dependencies. Moreover, major principles and components have to be complied with to utilize big data in such crisis-induced scenarios, i.e. strong technical infrastructures, local skill deployment, context-specific and ethical applied data incorporated in an experimental learning based KMS (Sarker et al., 2020; Scheffler, 2020; Scheffler & Vogl, 2022). Finally, in terms of the flood protection and drinking water supply function of the water association under regard in this study, the digitalisation project has to adhere to hybrid technological solutions as well. To be more detailed, a pure analogue process of handling all the technical equipment is a minimum requirement in case of a total blackout, under which digital processes would cease to function. Therefore, a fully digitalised approach in the project must always have a full analogue mirroring in the context of catastrophe scenarios, leading to the relevance of resilient structures in both the digital and physical world.

3.2 Sustainability and Ethics

The implicitly denoted proficiency of conducting well-informed decisions to employ resources and respective services more efficiently, directly influences sustainability, yet, requires solutions to various challenges (Appio et al., 2021; Ardito et al., 2018). Referring to water, Wu et al. (2020) state it as one of the pivotal components for the definition of smart cities in the context of smart water and the underlying holistic approach to water resource management, water infrastructure, respective water treatments and subsequent water supply. Hand in hand with digitalisation, following de Albuquerque et al. (2021), denote that the role of digital technologies such as big data and citizen-generated data enables transformation to sustainability. To succeed, systemic multidimensional prospects in terms of innovations for smart and sustainable city solutions are required (Tura & Ojanen, 2022). Nonetheless, following Tura and Ojanen (2022), state that sustainable evolutions presuppose innovations directed at organisational transformation and system creation, thus, reflecting the requirement for innovations as catalyst of institutional change on a large scale. Regarding the role of policymakers and the ongoing rapid development of AI, it is stressed that the promotion of AI can be seen as a 'double-edged sword', which according to Stahl (2022) may strengthen the AI industry, yet, may likewise lead to fatal consequences if ethics are neglected in the process. A summary of the ethical debate on forecasting procedures and AI implementations can be found in Vogl et al. (2022), which ought to be considered during the digitalisation projects final phase, namely, the implementation of advanced flood predictive algorithms and AI-based KMS solutions.

3.3 Knowledge Management Systems

Following, Kuang and Liao (2020) flood events are assumed to trigger learning processes in stakeholders, which if enabled with knowledge management can lead to successful learning processes and, thus, may insinuate flood resilience. However, the problem discussed in this paper and the problem of sharing knowledge to provide for more efficient environmental policy progress (as demonstrated in Scheffler, 2020) has already been established in Freeman (1977), yet, is still dominant today. Henceforth, the need for sustainability transitions has

widely been accepted in the scientific community, alongside the requirement of evolution of KMS to lead to more effective policy actions (Oliver et al., 2021).

It is relevant to identify specific knowledge and competency requirements for governing sustainability transitions related to the interconnected phases of envisioning, implementing and evaluating (Oliver et al., 2021). Furthermore, the process has to provide further knowledge development in terms of an iterative and holistic process (Oliver et al., 2021). Nonetheless, such deep-rooting changes in policy KMS will be considered disruptive and present challenges for, especially, traditional organisational models of knowledge delivery, however, is deemed essential to successful enable sustainability transformations (Oliver et al., 2021). Furthermore, a knowledge architecture consists of monitoring, data, information, assessment and knowledge, named MDIAK process (see A.4), which can support the policy processes as proposed by the European Environment Agency in hindsight of knowledge development processes (Oliver et al., 2021). However, Oliver et al. (2021) state limitations within the funding and cycle times due to long lasting planning periods, which are addressed in Scheffler (2022).

Building upon the previously denoted dilemma, Landriani et al. (2022) provide a systematic review about the critical role of knowledge in water service coproduction and referring policy implications. Finally, regarding disaster management, KMS play a critical role owing to certain practices, which are displayed in Oktari et al. (2020). Notwithstanding, following Oktari et al. (2020) state the practical implementation or realisation of such concepts as a current gap.

4 Practical Insights

As demonstrated within the previous section, the practical application of AI-solutions, KMS or AI-based KMS decision support systems based upon vast amounts of data is currently seen as a clear gap in science and practical applications. With the presented digitalisation project (see A.3) it is intended to a) close the gap and b) pioneer the practical implementation of such solutions.

4.1 Surface Water Plant

The introductory mentioned hybrid solution incorporated within the water association is realised by the combination of the pillars technical flood protection (TFP) and drinking water supply. An optimal TFP is ensured by means of the dam,

which has an ordinary high water retention volume of 4.5 Mio. m^3 to 5.77 Mio. m^3 at damming.

A minimum discharge of 500 l/s supports the water flow of the according river and, thus, the survival of the biotopes in case of drought. A hydroelectric power plant is operated via the bottom outlet, which covers the electrical requirements of the entire plant with up to 300 kWh in a climate-neutral manner and, additionally, supplies the future surface water plant with clean electricity on a pro-rata basis. Furthermore, the coating of said surface water plant will consist of a PV façade and roof and is expected to generate approx. 1.3 Mio. kWh/a. The surface water plant with an investment volume of approx. 65 Mio. EUR is expected to supply approx. 13.5 Mio. m^3 drinking water in combination with the groundwater production wells (+4.5 Mio. m^3) per year for the conurbation (see A.2). The quality of the surface water will be monitored by a consequent monitoring with automated analytics of the intakes and the reservoir and the treatment will be ensured by a parameter specific adapted MBS developed by IWW Mühlheim (Germany). This MBS is equipped with an ultrafiltration and functions in conjunction with the automated monitoring even under "worst-case" conditions. In summary, this represents an important step towards adaptation to climate change and building resilience in the event of a disaster as well as provide a sustainable solution coping with water stress in the future. Furthermore, it is planned to automatize all sensors and measurement stations to enable future real-time monitoring and big data collection.

4.2 Structure of AI-based KMS Decision Model

Following the existing literature, a combination of AI-based KMS decision models is seen as a scientific as well as a practical gap. Within the digitalisation project it is planned to implement an AI algorithm-based variant of Kingdon's multiple stream model (see A.1). To do so, the three streams have to be algorithmically deployed and encoded. For the problem stream, the MDIAK framework (see Oliver et al., 2021, A.4) will be automatized and recurrently elucidated. The politics stream, however, consists of human interactions, which are triggered, once a negative event enforces a political reaction (Herweg, 2015). Thus, (we reasoned) a potential solution may be to apply natural language processing (NLP) procedures paired with catastrophe prediction models to

anticipate political actions as well as to evaluate pre-defined potential solutions availabilities.

Finally, the policy stream can be anticipated via application of macroeconomic data, sentiment indicators for economical regimes as well as with profitability-cost calculations in combination with Behavioral Finance or psychological human pattern recognitions. The overall goal in this context is the AI-optimized anticipation of the maturity of the "window of opportunity" based on the combination of CSFs and big data. In addition, feedback loops will be performed and scenario-based reality models will influence decisions.

4.3 Evolutionary Digitalisation Project

Finally, it is of importance to briefly outline the contents of the evolutionary digitalisation project (see A.3.). As depicted in Section 3.1, it is vital that to enable a successful digitalisation procedure, in particular, at the extent of a critical infrastructure organisation, proper planning steps are to be adhered to. Therefore, the state-of-the-art in IT project management practises as well as information system and enterprise architecture management (EAM) guidelines are regarded. To be able to plan, structure and realise an IT project of the proposed scale and level of inherent and exogenous complexity, the best practices of the field of IT and architectural planning are deemed important to comply. Moreover, several frameworks and guidelines are consolidated in the given framework such as EAM, TOGAF-9, SLC, ConOps or evolutionary architecture designs and subsequently abstracted from pure software applications to business process design (see A.3). Furthermore, to plan the operative implementation thoroughly, the PRINCE II project management standard has been selected, since it is mostly suitable for projects that are more complex.

Following the set guidelines, the whole organisation is digitized and restructured, i.e. the current state is critically elaborated on, and business processes are optimized and prepared for digitalisation, among many other steps. This is done within a regulatory frame of critical infrastructure and IT laws and regulations in Germany and Europe. Finally, pre-defined goals will be evolutionarily (i.e. dynamically) implemented to meet the set goals of rendering technological capabilities to implement, adapt and exploit the technological possibilities granted by real-time big data, data science, AI and other

technological conceptions with the goal to provide efficient flood protection and drinking water supply in a hybrid setting.

Thereinafter, it is intended to implement various layers of technical applications, deploying data scientific and AI-driven algorithms to aid in the given tasks. Finally, it is planned to deploy advanced predictive algorithms as well as the presented AI-based KMS decision model in a phase plan based manner.

5 Conclusion

To conclude, within the water association's hybrid pilot project, a surface water plant has been realized with application of CSFs and a given KMS, which will provide means to digitalisation and sustainability in terms of coping with climate change. Moreover, the digitalisation project is presented, goals outlined and the aim to create a data-driven AI-based KMS decision model has been elaborated on as one final goal next to the enablement of technological solutions such as advanced predictions and digital knowledge transformations with regard to sustainability. Finally, it is seen during the practical realisation of the project that knowledge in itself is a binding key, allowing to respect all relevant factors and multidimensional features required to achieve a sustainable digitalisation strategy within a critical infrastructure organisation. Overall, the proposed evolutionary digitalisation project within the hybrid pilot project of the water association in Germany is seen as template for future project realisations and a first definite step towards coping with climate change and solving water stress in the future.

Finally, it is relevant to elucidate the research propositions given in Section 2. As depicted in Section 4.2, it is possible to deploy a CSF and AI-based KMS, automatizing the Kingdon's multiple stream model for management decision support in context of climate change and water stress in hindsight of digitalisation and sustainability. Given the stated importance of sustainability and digitalisation in the water sector, these factors should definitely be considered alongside the other CSFs presented in Scheffler (2022). Furthermore, given the clear lack of ethical guidance and practical implementations, as displayed in the literature, it is not possible yet, to discern, whether the presented AI-based KMS decision model is reliable and standardisable at scale, which is seen as current gap.

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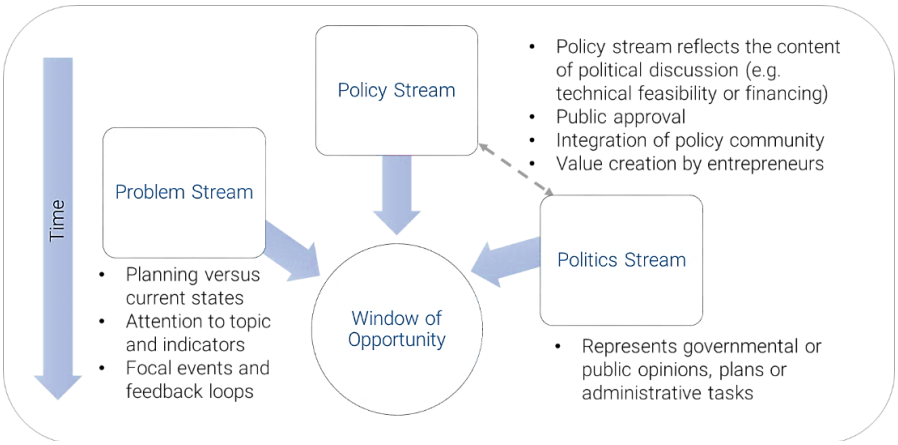
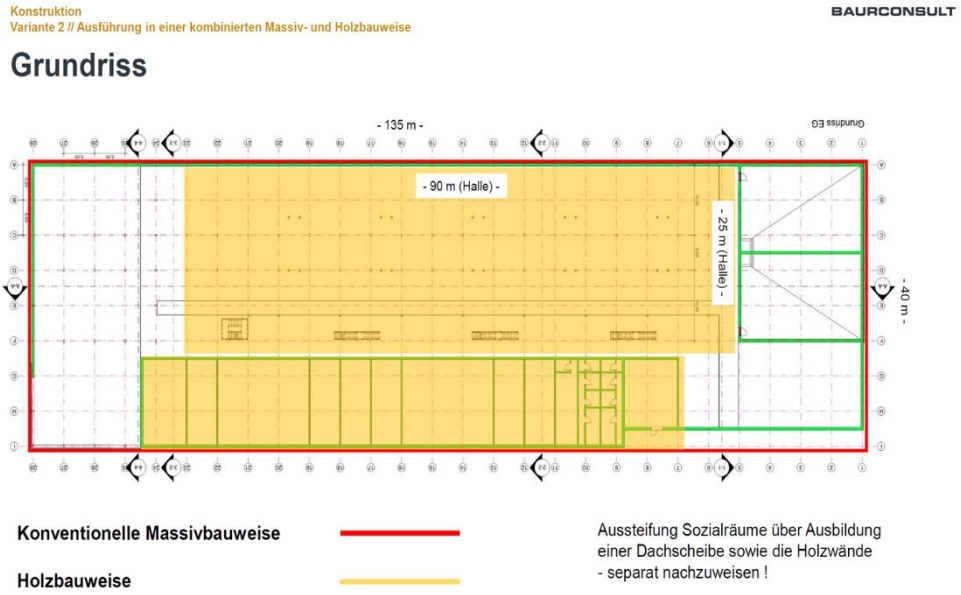
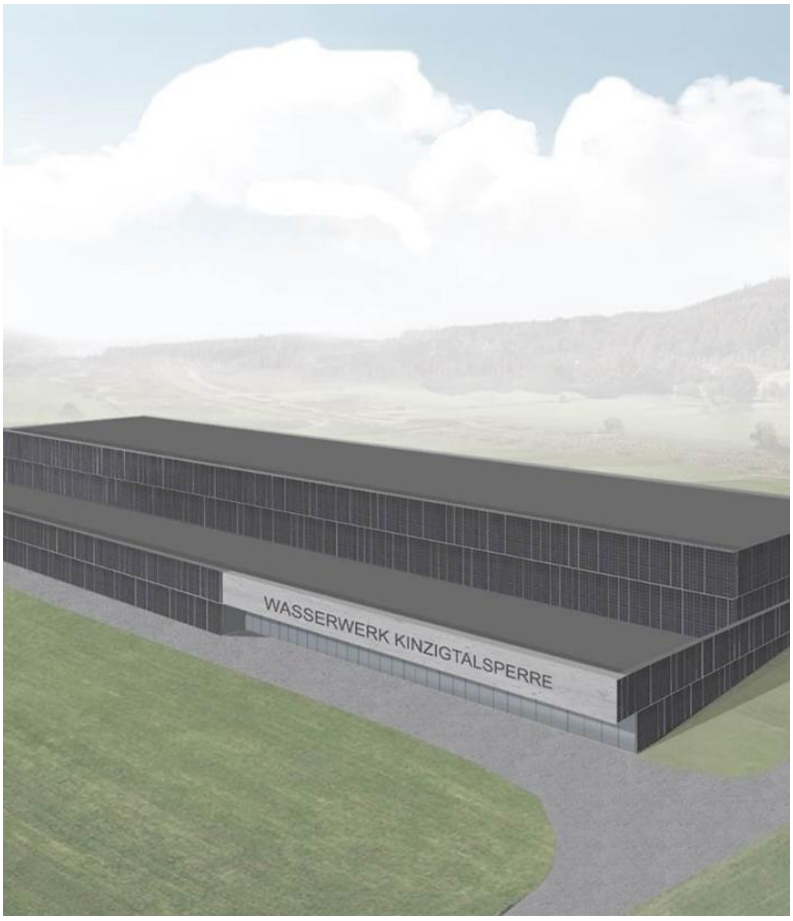
Appendix

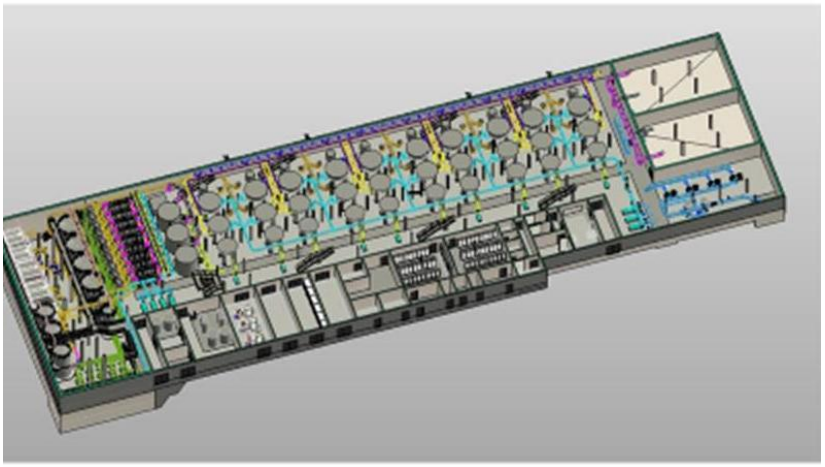
A.1 Kingdon's Multiple Stream Model



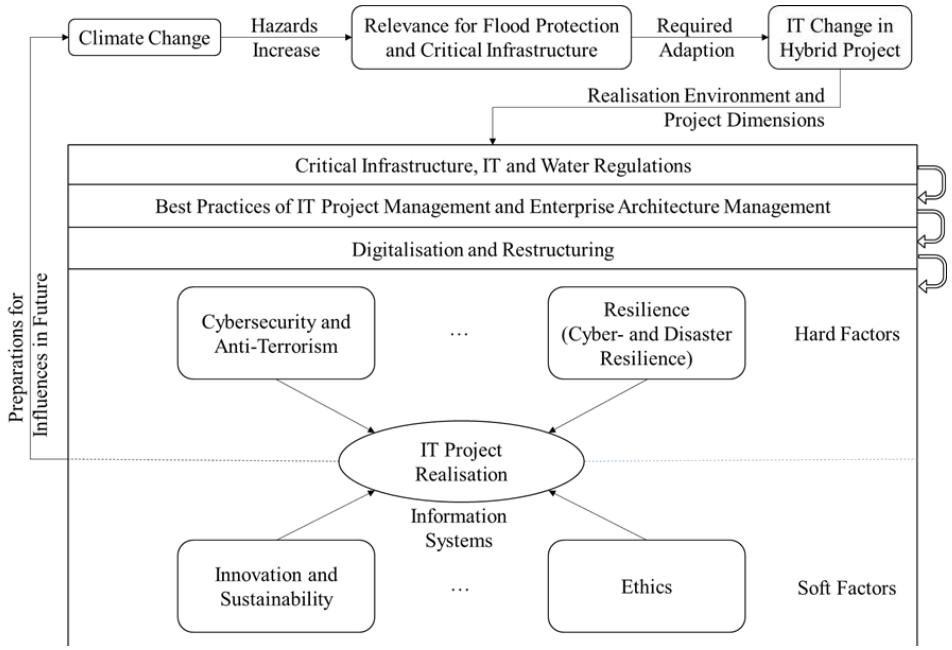
A.2 Surface Water Plant Graphics



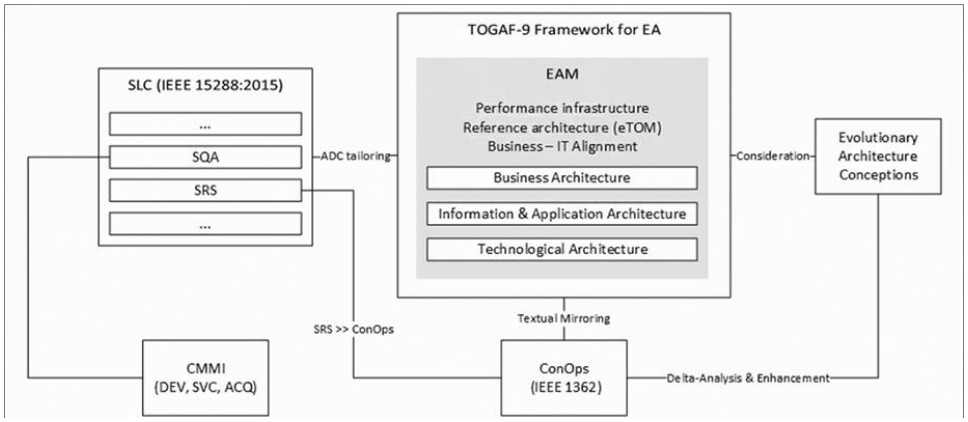

WASSERWERK KINZIGTALSPERRE



A.3 Taxonomy of Evolutionary Digitalisation Project



Source: Markus Vogl {Business & Data Science}



Source: Markus Vogl {Business & Data Science}

A.4 MDIAK process taken out of Oliver et al. (2021), Figure 1, p. 153

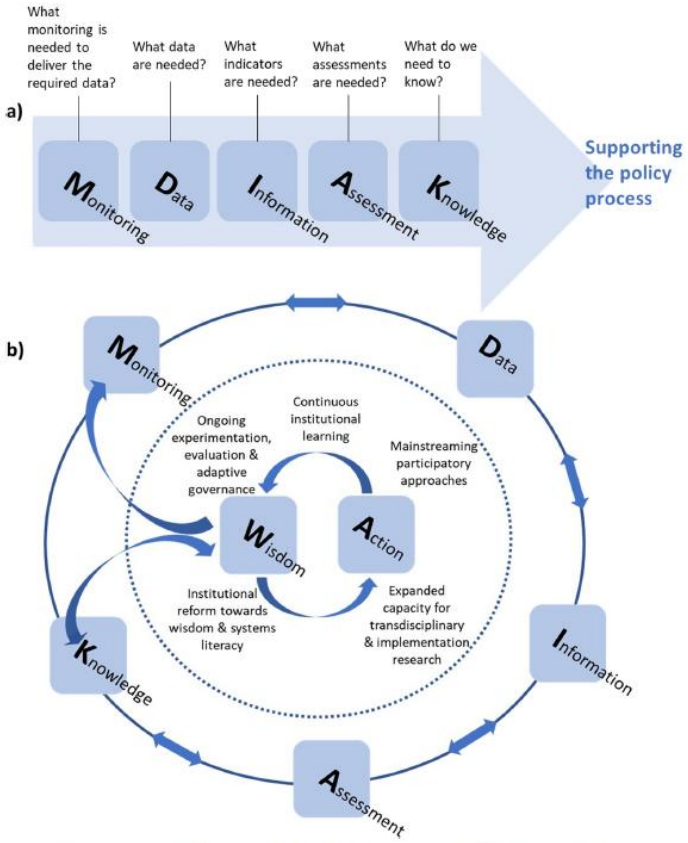


Fig. 1. Knowledge architecture for governing sustainability transitions. The 'MDIAK' framework developed by the European Environment Agency to help distinguish between the different phases of knowledge development to support policy processes (EEA, 2011; panel a). Panel b extends this with key considerations on how knowledge systems need to evolve to enable wise governance of sustainability transitions (see main text for further explanation).

Sustainability Information and Knowledge Management in Local Government

Harri Laihonen*

University of Eastern Finland
P.O. Box 1627
70211 Kuopio, Finland

Lotta-Maria Sinervo

Tampere University
33014 Tampere, Finland

* *Corresponding author*

Abstract

Sustainability has been extensively studied in different disciplines especially since the publication of the Brundtland commission's report in 1987. However, in public management as well is knowledge management literature sustainability has gained limited scholarly attention. Especially, there is a lack of understanding of sustainability as an issue that needs managing. Therefore, article approaches sustainability in organizational context and is interested in how sustainability is managed in local government and what knowledge is used to support management. While sustainability can be regarded as a pressing societal challenge, relatively little is known on how sustainability policies and strategies are implemented and managed in public organizations. In order to understand how public managers perceive sustainability as a management issue and define sustainability information, an interview study was carried out. The article analyses the data of 25 semi-structured interviews from branch and financial directors in Finnish municipalities to provide an in-depth knowledge-based view to the practice of managing sustainability in local government. The article contributes by developing new understanding about the different roles knowledge management can have in supporting public organizations and public officials to grasp the complex phenomenon of sustainability.

Keywords – Sustainability information; Sustainability management; Knowledge management; Public management, Local government

Paper type – Academic Research Paper

1 Introduction

This article aims to understand how sustainability is managed in the public sector and analyses how public managers understand sustainability information, its role in public management, and how they use it in their management tasks specifically in local government context. Sustainability has been extensively studied in different disciplines, especially since the publication of the Brundtland commission's report (WCED, 1987). While sustainability can be regarded as a pressing societal challenge that requires action in all sectors of society, relatively little is known about how sustainability is implemented and managed in public organizations. Previous knowledge management (KM) research has been scant (Martins et al., 2019), and especially for KM scholars, there is a need to better understand how KM can help public organizations foster sustainability.

In public management literature, research on sustainability is still at an early stage (Fusco & Ricci, 2019). There is a lack of understanding of sustainability in the context of management (e.g., Fiorino, 2010; Zeemering, 2018) because the main emphasis of previous research has been on policy tools and in developing indicators. Instead of this external view, this study approaches sustainability in the organizational setting of local governments. This article asks how sustainability is managed by the local government and the role of knowledge management in fostering sustainability. Most of the literature on KM and sustainability focuses on private organizations (e.g., Hörisch et al., 2015; Martins et al., 2019; Shiroyama et al., 2012), and one aim of this study is to learn from this literature and develop ideas for promoting KM in the local government. There is also an urgent need in practice to better understand how public officials take sustainability in their everyday decision-making and learn what management practices lead to improved sustainability (cf. Zeemering, 2018). Prior research has not thoroughly scrutinized the implementation of sustainability, that is, how sustainability policies and strategies are executed and managed in public organizations. Indeed, a key factor in working towards sustainability is the implementation of sustainability in practices and managerial processes. The article contributes by developing a new understanding of the different roles KM can play in supporting public organizations and public officials to grasp the complex phenomenon of sustainability.

The remainder of this paper is organized as follows. In the next section, we briefly review the KM and sustainability literature. The third section presents the

empirical methods used in this study. Section 4 presents the results of the interviews. In section five, we discuss the results, and section six draws some conclusions.

2 Literature on knowledge management and sustainability

The academic literature linking KM and sustainability in the context of local government or the public sector is still scarce. Therefore, this section provides a more general view of KM and sustainability. We briefly review the selection of studies that connect these two research streams. These studies have focused on the corporate context, which is typical in studies combining sustainability with managerial activities (e.g., Thomson 2014).

Martins et al. (2019) carried out a systematic review of the literature on KM and sustainability. According to the authors, the literature considers KM as "a new paradigm of development that aims to enhance compliance with the guidelines of economic, environmental, and social sustainability" (ibid., 490). The authors considered KM as a management mechanism for information sharing and recognized research gaps regarding KM in the context of sustainability. According to the authors, further research is needed regarding sustainability in small and medium enterprises and the role of universities as knowledge generators. The authors also highlighted the need for specific models, tools, and systems to facilitate the sharing of information and guidelines for KM implementation. Finally, they also pointed out that quantitative studies are lacking.

The analysis by Hörisch et al. (2015) reveals that larger companies apply significantly more sustainability management tools, even though these tools are also applicable to small- and medium-sized enterprises. The authors provide three different theoretical explanations for this finding. First, based on the resource-based view, it is argued that large companies possess more financial and human resources that enable them to gather information, develop expertise in sustainability management tools, and unlock the potential benefits associated with them. Second, legitimacy theory explains this finding by arguing that large organizations are far more publicly exposed. Third, absorptive capacity states that larger firms have more extensive knowledge bases for sustainability management and thus know more about the available options in this area. Hörisch et al. (2015) find also that knowledge about sustainability management tools is a crucial factor between strategy and implementation. These results are also relevant for public

organizations that are typically large and have a wide range of resources both in terms of human and financial resources. They are also exposed to public opinion, and the legitimacy of their decisions is evaluated externally. Moreover, public organizations are constantly evaluated in terms of the transparency of their actions and are held accountable to various stakeholders. In addition, big cities are regarded as points of reference to smaller ones as well as for private sector entities.

Alvino et al. (2019) discuss whether IC, through the implementation of KM processes, can influence the entrepreneurial orientation towards the creation of sustainable business models. Their bibliographic analysis identified that research published on IC and sustainability focuses mainly on the measurement of results in terms of increased business performance. The results also show that IC is linked to long-term value, but less attention has been paid to the use of IC in relation to the goals set by the 2030 agenda and established guidelines for companies. This finding resonates well with the public sector literature (cf., Zeemering, 2018). In this regard, there is a growing body of literature on smart cities in the context of sustainability (Karppi & Vakkuri 2020).

Shiroyama et al. (2012) propose an analytical framework for risk-related governance for sustainability. The authors note that different actors within society hold different viewpoints on sustainability; thus, there is a need for sustainability governance. This is especially true in the public sector, where different values and expectations must be reconciled (Laihonen et al., 2023). According to Shiroyama et al. (2012), governance for sustainability requires knowledge integration to address multiple dimensions of sustainability and uncertainty. They state that multi-actor governance involves public–private and multi-level interactions, which are needed to obtain agreement on sustainable actions among actors for designing and establishing resilient systems. The authors emphasized the importance of a reflexive approach and learning that necessitates knowledge integration among experts in various academic fields and stakeholders. Regarding sustainability management, Hu et al. (2018) highlighted the importance of KM, organizational learning, and data-mining systems adopted to capture the best practices of sustainability initiatives.

Several studies have been conducted in the construction industry, in which knowledge transfer is considered a critical success factor for sustainability management. Robinson et al. (2006) suggest a maturity roadmap to facilitate the implementation of a KM strategy. They found that KM is inextricably linked to

corporate sustainability and suggested a mechanism for organizations to benchmark KM activities and to develop a KM strategy that would improve their activities. The authors argue that bringing knowledge or intangible assets to the forefront of an organization's business strategy will have a significant impact on the future wealth of organizations, and that developing a KM strategy enables an organization to unlock and leverage the different types of knowledge, to identify competencies required to become a forward thinking and learning organization with the ability to put sustainability principles into practice. Schröpfer et al. (2016) examined knowledge transfer (KT) practices in construction projects. In general, the authors suggest that enhancing KT between all project participants could help secure a certain standard of green building quality in the long run. According to Schröpfer et al. (2016), many actors involved in the construction process claim to strive for sustainability, but the ways in which different stakeholders perceive and translate it into practice vary. The concluding argument is that enhanced KT between project participants offers a solution to achieve a certain quality of the built result.

Preuss and Cordoba-Pachon (2009) aimed to determine how KM processes can foster (or impede) progress towards corporate social responsibility (CSR). They reviewed KM literature to identify areas that are particularly relevant to managing a company's social and environmental externalities toward sustainability. The authors note that KM is predominantly internally focused, whereas CSR is mainly concerned with external stakeholders' and companies' responsibilities to society. This excessive internal focus of KM is something that Laihonen et al. (2023) also pinpoint when discussing criticisms levelled at knowledge management. Evangelista and Durst (2015) provided a structured literature review of KM and KM strategies in the environmental sustainability practices of logistics service providers. The authors identified three basic elements of appropriate KM approaches and strategies: customer relationship management, quality of human resources, and the adoption of information and communication technology tools and systems. These three areas of sustainability management are relevant for all organizations, whether public or private.

3 Methodology

To understand how public managers perceive sustainability as a management issue and to define sustainability information, an interview study was chosen as

the most suitable method. Empirical data were collected using semi-structured interviews. Interviews are an efficient method for gathering rich empirical data (Eisenhardt & Graebner, 2007). This article analyzes the data of 25 semi-structured interviews with branch and financial directors in Finnish municipalities to provide an in-depth view of the practice of managing sustainability in local governments. Data were collected during October-November 2022, when Finnish municipalities were at the edge of a historical social and welfare service reform. Interviewees were selected to represent the service branches that remained in the responsibilities of municipalities after the reform: education, environmental, technical, development, and city planning services. Interviews were conducted in teams, video-recorded, and transcribed verbatim. All interviews lasted approximately an hour.

The interviews dealt with the following six themes:1) sustainability as a phenomenon and part of your work, 2) sustainability and municipal strategy work, 3) management of sustainability, 4) sustainability knowledge base, 5) sustainability reporting, and 6) external steering mechanisms for sustainability. In this article, we focus on Themes 1 and 4 and first show how the interviewees perceive the phenomenon. Second, we provide preliminary results on the role of sustainability information and KM. During the analysis, the interview transcripts were first carefully analyzed line by line to recognize different interpretations and definitions. In the second phase, the focus was on sustainability information and the underlying knowledge processes. Through this two-step analysis, the researchers gained an understanding of the different roles and impacts of KM on sustainability management.

4 Results

4.1. What is sustainability – different views and definitions

The interview data showed how different interpretations and definitions of public managers affect sustainability, depending on their position and tasks. Therefore, it is important to understand that the definition of sustainability depends on several factors.

The financial directors approached sustainability from the viewpoint of financial sustainability. Financial sustainability was also highlighted by most of the directors, which was less obvious because of their strategic position and role in

resource allocation decisions. Financial directors defined financial sustainability for example in the following ways:

> *"Financial sustainability means that you do not live beyond the resources, not make the type of settlements that burden the city's future or the future of the economy so that you do not basically eat its base or other. It is a durability." [Financial Director]*

Like all interviewees, the directors of the education branch approached the phenomenon as a major societal change and emphasized the multifaceted nature of sustainability management. However, for them, social sustainability played a special role in how they approached the questions regarding the definition of the phenomenon and how it is reflected in their work.

> *"All four dimensions of sustainable development, economic, social, cultural and ecological, are important to us. All of this is very strongly reflected in our operations, the aim is that our operations are financially sustainable so that we have resources going forward as well, we take into account what is happening in the operating environment." [Director of Education]*

Infrastructure and development directors pretty much continued the same agenda but an emphasis on ecological and environmental sustainability could be recognized.

> *"Well, the first three things that come to mind in terms of sustainability are ecological sustainability, then the economic perspective, economic sustainability, sustainable municipal economy. And perhaps the third point of view in urban structure services, which is emphasized, is this kind of social sustainability or sustainable urban structure." [Director of Urban Planning and City Infrastructure].*

It is also worth noticing that local government has an important role in fostering the vitality of the area. This viewpoint is well captured in the following quote from an interview with a Director of Development.

> *"For me, that sustainability is how this city remains a growing and developing city in terms of both attraction and holding power. In other words, the kind of continuous, permanent development of the city in such a way that all the time it is ensured that the conditions for development exist and the requirements of the environment are taken into account in that development." [Director of Development]*

From the KM viewpoint, especially concerning decision-making information, it is critical to understand how organizational objectives affect the priorities and

emphasis of KM. The strategic KM literature has highlighted that "business objectives" should drive all knowledge initiatives (e.g., Zack, 1999; Hansen et al., 1999; Laihonen & Mäntylä, 2018) and this concerns also defining, gathering, and use of sustainability information.

4.2. Sustainability information – what is it and how is it used in public management?

Following their different positions and roles in the organization, the interviewees also defined sustainability information differently. Discussions with directors did not really go into detail; directors only gave some overall direction on the concrete metrics and data used for evaluating their services. In general, all directors linked the discussion to city strategy and, in some cases, to the legislative task of the city. The following quote from the Director of Technical Services illustrates the ambiguity of sustainability management in the public sector:

> *"Yes, of course, I think about this point in relation to sustainability in that way, a bit like a tripod, you probably can't think of it specifically from the point of view of sustainable development, environmental legislation and environmental protection, the ecological point of view, that of course it is important from the point of view of my own industry. Since I am in the role of a leader, of course the economy also comes into question as a whole, that the economy is also on a sustainable basis, and this balances out certain choices. […] there are also very strong values in this field of activity, and through that the social perspective also comes into play, i.e. issues of equality and equality. Inclusion is also very strongly included as a legislative program here. Such a diverse field, I see these things from the point of view of the ecological field, the economic field and the social field. Such a mixed fruit soup, and of course, from time to time, one is emphasized more than the other." [Director Of Technical Services]*

Financial directors emphasize the role of financial information. They work with budgets, investments, and tax revenues, and this information is critical to their role.

> *"At the whole city level, I would say that from the point of view of monitoring, the top should be the income statement. Of course, investments in relation to the targeted amount. it says a lot about the*

activity as well, about the ability to promote what has been planned. […] From a monitoring point of view, if we are thinking about the government level, then we need to pay attention to two different things. There is the development of operating expenses and income in relation to the budget. […]And operating margin is of course important in the sense that then we respect the things that happen in our core tasks. […] At the government level, it is natural to always assess the outlook for tax revenues at a fairly precise level." [Financial Director]

For educational directors, important decision-making information relates, for example, to the well-being of both teachers and students as well as the social environment provided by the education services area.

"In the entire strategy work, we have taken these SDG indicators. We chose ten, those that we felt were the most relevant for us in. And then, of course, there are others besides these SDG indicators that we consider, for example, school health surveys, it is a really important document for us, and on the basis of that we draw up well-being plans, and which in turn affect that well-being. […] In terms own service production, there are different metrics that are then monitored, related to meals, energy use and things like that. And, of course, also social sustainability and how you do it, how people work and so on, so these types of metrics exist." [Director of Education].

It was already evidenced in the previous section that, because the definition of social sustainability covers many aspects, the required information cannot be easily defined and is ambiguous.

"There is a lot of variety. For us, student absences, the amount of support needed, etc. New needs are emerging […] Then, service processes and service network. How much with different calculations, how much, for example, students from different schools cost us per student." [Director of Education]

One of the main points of sustainability management and the needed information and knowledge is the overwhelming amount of data.

"I would say that the main question related to information is not that we should have more of it, but that existing information should be simplified and bundled, and we are currently working on such reporting that would bring together the essential information to support management." [Director of Education]

The question related to sustainability information also challenged the infrastructure and development directors.

> *"Well, financial information of course. Continuously, as far as the finances of one's own operations are concerned. We make a lot of use of data related to demographic development. That is public information. And population, migration, all of this is of course the same basic thing, we already use it in connection with planning. We use not only information on resources but also various information that is collected. Our 'resource wise program' has about 180 separate measures. Also, location information is very important." [Director of Urban Planning and City Infrastructure].*
>
> *"We compile an ecological road map and the data of the related meters, from which we can see whether our actions are sufficient. We are thinking about how many solar panel sites we need to put into use every year, we have an energy saving working group that monitors the energy consumption of our buildings on a property-by-property basis, and of course, the financial monitoring systems are part of where we monitor how our operations for that year are progressing." [Director of Environmental and Technical Department]*

One interviewee nicely summarized that it is not only directors that know it all, but their role is more in a team building that is able to efficiently gather and use various information and knowledge.

> *"I don't need to know everything myself, but I have a good orchestra with very good experts, and they are experts in their field and do their work with a certain passion and manage that knowledge reserve better I could. I trust them. For me the main thing is to ask the right questions." [Director Of Technical Services]*

5 Discussion

The aim of this study was to investigate sustainability management in local governments. Special attention was paid to sustainability information and the knowledge base of sustainability management. Local governments are a fruitful and relevant research object for sustainability management research, as their role in promoting and creating sustainable practices has been recognized (e.g., Krause et al., 2016). Local governments carry out local activities for the local people, and they inevitably play a special role in promoting sustainability. This study

demonstrated that sustainability can be managed in many ways and at many levels.

It has been noted that sustainability is at the heart of public administration as a starting point, main aim, and desired outcome (e.g., Fiorino 2010) and that there is an urgent need to better understand how public officials implement sustainability (cf. Zeemering, 2018). This adds public sector sustainability management to Martins et al. (2013) list on the important and highly relevant areas of future research. Cities and public organizations more generally are big organizations with multiple resources, and it is therefore of great importance to prioritize sustainability, allocate resources, share information, develop expertise, and encourage the use of various tools to support sustainability management (cf. Hörisch et al., 2015). In addition, the publicness of their activities necessitates a careful analysis of the sustainability of all services. It is also critical that sustainability management is not considered only as a transfer of sustainability information (Schröpfer et al., 2016), but also its strategic implications need to be considered (Robinson et al., 2006), which also relate to the management of intellectual capital, which poses a critical success factor for any knowledge-intensive organization (cf. Alvino et al., 2019). Sustainability management must consider both short- and long-term strategic objectives.

Based on our data, sustainability is a well-known phenomenon, but its interpretation involves caution, uncertainty, and a lack of awareness. Sustainability appears as a phenomenon recognized as important in strategy work; however, in terms of implementation, the responsibilities and tasks are not clear. Therefore, it can be stated that there should be space, time and opportunities in the municipal organization for the interpretation of sustainability and the building of a common understanding. This clarifies the responsibilities of sustainability management. Knowledge integration and multi-actor governance are required, as highlighted by Shiroyama et al. (2012), to agree on sustainable actions among actors in designing and establishing resilient systems. Sustainability management necessitates continuous dialogue between different actors and levels of society about what is acceptable and the assessments of what to aim for as well as with what means to build the desired future (Laihonen & Mäntylä, 2018). This type of joint knowledge formation (Laihonen et al., 2023) is a prerequisite for structuring multifaceted and wicked problems such as sustainability.

It has become evident that learning from sustainability information is a key mechanism in sustainability management. This was highlighted by Hu et al.

(2018), who stressed the importance of KM, organizational learning, and data mining systems in capturing the best practices of sustainability initiatives. Preuss and Cordoba-Pachon (2009) discussed the different standpoints of KM and CSR and stated that it is not enough in sustainability management to focus only on the internal efficiency of operations (see also Laihonen et al. 2023). Thus, there is a need for a balanced measurement of the success of sustainability management. This was also highlighted by Evangelista and Durst (2015), who recognized customer relationship management, quality of human resources, and the adoption of information and communication technology tools and systems as the three basic elements of KM in environmental sustainability practices. This finding has important implications for the perception of sustainability information. In our interview data, financial information emerged as the most frequently used information from the local government. In addition to financial information, various expert information, analyses, publications, and statistical information form the information base public managers use to support their decision-making. The information provided by national institutions and actors (e.g., central government actors and ministries) was also perceived as useful in sustainability management. It was somewhat surprising that managers were quite satisfied with the available sustainability information. Sustainability information is used for budgeting, goal setting, operations management, strategy implementation, procurement, and investment. The interviews also evidenced the multidimensionality of sustainability information. The data showed that information is available from different sources; however, information on sustainability is not always identified. In addition, sustainability information often remains siloed into individual service branches or areas of responsibility. Despite this, no specific wishes regarding sustainability information came up in the interviews It appears from the data that it would be hoped that the information would be as comparable as possible, in which case the interpretation of the information could be done between different municipalities. National and inter-municipal statistics and numerical data are particularly useful. Overall, based on the data, it can be interpreted that the role of information, and thus its management, is perceived as an important element in managing sustainability, but identifying sustainability information needs is still perceived as difficult.

6 Conclusions

Sustainability management should not be approached from a single perspective. It is necessary to consider the different starting points and capabilities of local governments to deal with such multifaceted phenomena. This research has revealed the versatility of conversation and provides tools to conceptualize the phenomenon. In this regard, our key message is that managing sustainability requires a comprehensive review of local government organizations and consideration of different sustainability perspectives. Based on our findings, sustainability management seems to focus primarily on quantifying and making the phenomenon visible. This is important, but from a management viewpoint, even a slightly imperfect metric can sometimes be useful in indicating the direction of development. In recent years, the use of sustainability information has been strongly emphasized in performance management literature. We call for this, also in terms of sustainability management. A more structured discussion on how sustainability is positioned in other areas of performance is needed. According to our understanding, it is not a new performance goal per se but a phenomenon that forces us to redefine the traditional ways of conceptualizing performance in the public sector. This finding has clear implications for KM and requires further investigation.

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UNESCO Buffer Zones and Territorial Identity: Design as a Potential Tool for Context-Heritage Integration

Sara Ghirardini

Politecnico di Milano
via Edoardo Bonardi 3, Milano

Abstract

In the last thirty years the notion of heritage has deeply changed, and the attention has shifted from the materiality of monuments, as bearers of intrinsic values, to a wider recognition of cultural heritage as a process that increasingly involves the territorial context and its dynamics. UNESCO official preservation tools include the definition of a buffer area surrounding an enlisted property as a non-compulsory added layer of protection to the heritage core, but, without further specific criteria and purpose, this remains as a mere generic "defensive shield" instead of becoming a contact point between heritage and territory. The contribution critically investigates how the implementation of UNESCO *buffer zones* is conflictual with the more recent compulsory *management plans*, theoretically fostering the inclusion of local dynamics in valorisation policies. Design and spatial transformations, that are fundamental components of a living cultural environment, are mostly excluded from the development of strategic interconnections between heritage sites and their surroundings, and they are mainly seen as threats to the heritage integrity and authenticity.

In this framework, the analysis of case studies highlights the potential of design actions in the heritage-context reconnection. The selected examples – both in and out of the UNESCO system –, are projects able to conjugate the territorial transformation processes with the heritage preservation priorities in a tentative to encompass the idea of architecture as a practice of care of heritage-related territorial fragility. Starting from these examples, the study of how design actions can be integrated both in the process of definition of buffer areas (*cognitive framework*) and in the drafting of the management plans (*interpretation framework*), defines a methodology that could activate new forms of preservation policies, that take into account the need for a renewed and shared knowledge of local traditions and for a valorisation that goes beyond the heritage site boundaries. The narrative and activating potential of architectural transformation cannot be excluded from the valorisation policies, and rethinking the role of UNESCO *buffer zones* can be crucial in a new balancing between preservation instances and territorial development.

Keywords – Buffer zone, territorial fragility, design, cultural heritage

Paper type – Academic Research Paper

1 Introduction: a change of perspective in heritage vision

In the definition of what heritage is, the last thirty years have seen a shift in focus from the materiality of objects, considered as witnesses of a past to be preserved, to the concept of the value these witnesses carry, widening the vision to immaterial and contextual aspects. The "static" idea of heritage, typical of 19th century western culture, linked to the physicality of artefacts to be preserved and/or restored, has gradually been overtaken on a theoretical level by a dynamic vision, in which cultural value is recognised in terms of significance rather than signifier; conservation and enhancement policies, though slowly and with difficulty, are embracing this change, widening their scope to involve territorial systems. On the one hand, the international scientific and academic debate is increasingly focused on an inclusive idea of heritage as cultural practice (Smith, 2006); on the other hand, this change of perspective has been slowly taken up by national and international institutions committed to the preservation of cultural heritage. First of all, UNESCO, which established the list of intangible cultural heritage in 2003 and has seen an increasing presence in the World Heritage List (WHL) of inscriptions of properties with a broad territorial scope, such as cultural landscapes or serial sites.

2 Heritage-territory relationship in the UNESCO system: management plan and buffer zone

The change of perspective on cultural heritage is a phenomenon of an interdisciplinary nature, which from an architectural point of view leads to a new consideration of the relationship between a site or monument and its context, linked to an active process of constant construction of a living place, bearer of recognised cultural values, to be protected and enhanced as a whole. This inevitably influences cultural heritage protection systems and practices, traditionally focused on safeguarding the physical qualities of circumscribed sites or places with clearly defined perimeters. For properties listed in the WHL - or in the tentative list - UNESCO guidelines do not provide direct legal constraints related to property protection: however, through the *Operational guidelines for the implementation of the Heritage Convention*, some specific tools are defined that must be implemented for all sites, and that influence and address the relationship between a property and its surrounding territory. Since 2005, the

drafting of a management plan has been mandatory for each WHL-enlisted or candidate site; this strategic management tool aims not only at organising and monitoring activities to protect the heritage in its physical component, but especially at safeguarding and promoting the values linked to it, through the involvement of stakeholders and local communities. The role of management processes in the connection between cultural heritage and the territorial context is made explicit in the Resource Manual *Managing Cultural World Heritage*:

«Heritage place cannot be protected in isolation or as museum pieces, isolated from natural and man-made disasters or from land-use planning considerations. Nor can they be separated from development activities, isolated from social changes that are occurring, or separated from the concerns of the communities. » (UNESCO, 2013, p.13)

The system of heritage management influence should therefore extend well beyond the geographical boundaries of the properties listed in the WHL, and involve portions of the territory of different sizes according to the strategies adopted, which however fall under different regulatory and administrative types, thus making the implementation of effective projects very difficult.

Among the UNESCO promoted tools, there is a possible delimitation of settings and areas of influence - the so-called *buffer zones* - which could take charge of structuring the relationship between heritage and territory, acting as a connective tissue, but is most often relegated to an anachronistic role of a defensive shield for heritage against external "threats". A world heritage buffer zone is the non-compulsory delimitation of an area outside the core property, and therefore not included in the WHL, but which can be established as an added level of protection for the site's preservation. Envisaged by the *Operational Guidelines* since the establishment of the WHL in 1977, buffer zones are currently included in the "Protection and management" section of the UNESCO regulations, and defined in Art. 104:

«For the purposes of effective protection of the nominated property, a buffer zone is an area surrounding the nominated property which has complementary legal and/or customary restrictions placed on its use and development to give an added layer of protection to the property. This should include the immediate setting of the nominated property, important views and other areas or attributes that are functionally important as a support to the property and its protection. The area constituting the buffer zone should be determined in each case through appropriate mechanisms. Details on the size, characteristics and authorized uses

of a buffer zone, as well as a map indicating the precise boundaries of the property and its buffer zone, should be provided in the nomination.»

Despite the changes made over the years to the official definition of world heritage buffer zone, its role is still very uncertain and difficult to be grasped by the managing bodies of both heritage and the surrounding territory. In 2008, an expert meeting held in Davos explored in depth the issues related to the definition and use of buffer zones, trying to highlight, also through the presentation of "best practice" cases, their potential as a connective fabric for the relationship between heritage protection and territorial development; however, what emerged above all were the criticalities linked to a superficial interpretation of their role, often limited to the forced tracing of a perimeter on a map (Martin and Piatti, 2009). The Davos expert meeting represents a key moment for the theoretical change of the role of UNESCO buffer zones, from a passive tool of exclusion and defence to a connective fabric for the interaction of heritage and territory. The key to the innovative interpretation of the role of buffer zones lies in the recognition of the need to address, at a wider scale than the perimeter of the monument, both threats and opportunities, adding a connective function to the defensive nature of buffer zones. It is identified as a potentially effective tool for heritage protection, but sometimes not sufficient to respond to different territorial demands and opportunities. A more nuanced concept with respect to the rigid geographic perimeter of buffer zones is the "area of influence", which is indicated in the Davos report as a possible alternative terminology to identify territorial contexts that are not so strictly defined by boundaries and limits. The possibility of using an alternative vocabulary to the term "buffer zone" is also outlined, which State Parties can define according to the management needs and cultural and linguistic characteristics of each country, to be able to communicate their value more clearly to local stakeholders. The expert meeting, in an attempt to update the concept of world heritage buffer zone and make it more comprehensible at local level through an articulated and more varied nomenclature, highlights the difficulty - or perhaps the impossibility - of giving a clear and univocal definition, and the need to broaden the matter of the relationship between heritage and territory by adding further levels of interpretation. In fact, the buffer zone delimitation strategy promoted by UNESCO responds on the one hand to the need of applying protective regulations with respect to heritage, while on the other hand it refers to an original political-military principle - namely that of the buffer zone - which is often an area "cut

out" from the active territorial fabric that becomes a passive element, in order to fulfil its role as a "neutral place". It is easy to see how such use of a buffer zone clashes with the contemporary idea of heritage as a cultural practice that draws substance from a living context, active in the production of place value, in which the setting cannot be reduced to the crystallisation of a static and passive image. Fifteen years have now passed since the Davos expert meeting, but the practical implementation of world heritage buffer zones has not yet fully absorbed - except in rare cases - the potential of this tool. Although their use as protective perimeters is now widespread, and their geographical scope extended, buffer zones remain mainly passive areas of application of restrictive regulations (Valentino, 2018) - often poorly coordinated and overlapping with each other - which generate stalemates in territorial development, in the name of an alleged safeguard of cultural heritage that contradicts the very contemporary meaning of heritage as part of a living cultural fabric. Buffer zones and management plans, instead of working in a complementary and coordinated way on the exchange between heritage and the contemporary context, often travel on parallel tracks, with little interrelation and with different objectives, causing a disconnection between the management systems of the World Heritage site and the local territorial reality. The valorisation strategies promoted by management plans, in fact, aim at involving the different stakeholders through intangible and episodic actions - such as temporary events, educational activities and workshops, communication and digital attractiveness - but rarely contemplate actions of transformation of places that structure - in the short and long term - a potential development of local communities in correlation with the valorisation of cultural heritage. Buffer zones, on the other hand, instead of being understood as a framework for deploying the potential deriving from the contact between universal heritage and the sustainability of local development, are left on the margins of management and transformation strategies, and become fragile parts of the territorial fabric due to the numerous constraints imposed by heritage conservation. In both cases there is a lack of design, understood as the practice of care for space, which structures the transformative strategies of places.

3 The project as a practice of care and significance reconnection between heritage and territorial identity

It is unthinkable to prevent a living territory from transforming itself in accordance with the social, economic and cultural changes of its contemporaneity. This consideration is also well recognised in the field of cultural heritage, and is witnessed by the growing attention paid to the category of cultural landscapes, established in the WHL since 1992 and since then increasingly at the centre of studies on the values of a widespread and living heritage, inextricably woven into the fabric of the territory (Carta, 2002). In addressing a type of heritage so different from the traditional nineteenth- and twentieth-century monument, the fundamental conceptual shift in preservation policies aims at balancing conservation and valorisation, where the former loses the connotation of static crystallisation of a supposedly original and authentic state, to allow the latter to promote heritage values in synergy with ongoing socio-economic processes. However, what is excluded from the current safeguarding and valorisation instruments - UNESCO and others - is precisely the more concrete aspect of the reality of places. In order to ensure that the transformations implemented are compatible with heritage values, the imposition of constraints and prohibitions is not the solution; it is rather necessary to define a proactive and project-based vision, which channels the transformative thrusts towards sustainable and beneficial objectives both for the valorisation of cultural heritage and for local development. As Emery emphasises, understanding architecture as therapy of the space means *first* putting into practice a design of an essentially relational type, focusing on the qualitative implications of the transformations brought about through the planned works.

«To cure means to manifest relationships and to preserve them, to relate to natural otherness and to the fabric of pre-existences in a different way than the colonising way of overcoming and almost unconditionally denying the other. » (Emery, 2007).

From this point of view, architecture is not to be seen as a demiurgic and totalising gesture, boasting a self-referential protagonism, but rather as a discipline that studies and structures in a holistic manner the relationship between human activity and the space in which it takes place.

In the last decade, a number of valorisation project experiences have been realised that are particularly significant for the heritage-context integration; they

are mainly outside the UNESCO sphere, in places where the incumbent constraints are less limiting, and at the same time where the construction of an effective heritage valorisation system is fundamental for territorial development. In the present contribution, two international case studies not belonging to the WHL are briefly presented, which are illustrative of the role that architectural design can play in the reconnection of significance between heritage and the territorial context. They deliberately refer to different heritage types and cultural contexts, but reveal some common features in terms of design approach: the Chengtoushan Archaeological Park, located in the heart of rural China, has found in the architectural and landscape enhancement project the key to reconnecting the archaeological site with the living agricultural culture that generated it millennia ago; in Alsace, a French region known above all for its wine production, the design of the Chemin des Carrierès has returned the ancient quarry railway route to local life as a new slow infrastructure, reconnecting the different identity assets of the territory.

3.1 Chengtoushan Archaeological Park

Discovered in the 1980s in the poor rural countryside of Hunan Province, the archaeological site of Chengtoushan turned out to be the oldest city in China, and the oldest trace of rice cultivation ever. The cultural site, which has been immediately protected at the national level, has, however, over time created several problems for the development of local activities: initially, the protection system provided for the expropriation of large agricultural areas in the surroundings of the archaeological area as limits to preserve its authenticity and integrity, exacerbating an extremely widespread condition of poverty among the local population; later, in order to promote the site's tourist attractiveness, expensive monumentalisation works were financed and partially carried out on the access roads and surroundings, consisting of large museum buildings and wide avenues with an urban imprint, lacking any relation to the context and strongly impacting on the structure of the territory. When the landscape design studio Turenscape was called upon to rethink the relationship between the site and the surrounding landscape in 2015, the situation was of neglect and decay, with poor attractiveness and no connection between the local communities and the archaeological area. The project was aimed at structuring the vast area around the site (approximately 20 hectares) as an agricultural and archaeological

park, returning part of the land to the local communities to be used for visitable rice crops, where tourists can understand the contextual reality that supports the values of the archaeological heritage and take part in it. The design strategies implemented refer to three scopes: the strictly archaeological one, constituted by the circular site of the ancient city, surrounded by a ring-shaped pond; the landscape one, reconstituting a vegetal system composed of both cultivated fields and plantings to restore the local ecosystems; the architectural one, identified by the structuring of the paths and centred on the glass bridge suspended over the fields that allows access to the heart of the site. In the first scope, intervention was minimal: the archaeological area was interpreted as a place for silence and contemplation of the past, and only the minimum interventions were carried out to guarantee accessibility. Design efforts were concentrated on the second and third areas, which are deeply interconnected. The land returned to cultivation, supplemented by a vegetation project that designs its structure and regulates water management, is configured as an open-air rice museum, thanks to the alternation of cultivated species and the use of traditional agricultural techniques. Placing itself at the same time in continuity with the surrounding extensive cultivation and as an interpretative threshold of the archaeological site, the park acts as a filter to protect the heritage authenticity, and adds an important reading level for visitors, who, thanks to the glass walkway suspended four metres above the fields, can approach the heart of the site in a slow and interesting way, crossing space and time and adding interpretation layers of the history and characteristics of the place. The glass bridge becomes the true landmark, and offers a panoramic view of the archaeological area, set in its contemporary landscape context. The other paths, built as wooden footbridges at ground level, allow the visitor to explore the park in its different aspects: not only the cultivated areas, but also the marshy ecological areas and the different pavilions, newly built and already existing, which implement the knowledge of the area. The realisation of the project, completed in one year, has had an immediate feedback in terms of tourist attractiveness, particularly of short and medium proximity, increasing the local populations' awareness of their own origins and cultural traditions; a broader level of notoriety, both national and international, has been achieved thanks to the recognition of the World Landscape of The Year award at the 2017 World Architecture Festival, while the local communities benefit from an economic development linked to tourist flows and their induced activities.

3.2 Chemin des Carrières

The case of Chemin des Carrières addresses a less obvious cultural heritage, which may appear irrelevant in terms of material assets, but plays an important role in local history: it is in fact the recovery of a short railway line, created at the beginning of the 20th century to carry stones and quarry materials from the hilly area of Saint-Nabor to the plain towards Strasbourg, and used until 2002 to transport goods and passengers along an 11 km route, linking a number of villages in the Alsatian Bas-Rhin region. The transformation of this route into a pedestrian and bicycle path, promoted by the local community association, exploited the infrastructure's potential for the valorisation of the area's complex cultural heritage and landscape system, made up of the intertwining of historical events, production activities and natural treasures.



Fig.1: two of the architectural landmarks along the 11 km Chemin des Carrières path. Photos by the author

The valorisation project, designed by Reiulf Ramstad Architects and completed in 2019, takes concrete shape in the redefinition of the pedestrian and bicycle path that incorporates the traces of the old tracks, bringing out at times the reminiscences of the railway structures - stop barriers, crossroads, station points, water pumps - as the fil rouge of a narrative that, starting from the "pretext" of

the quarry's productive past, becomes a trace for the grafting of other stories. Along the route, in fact, at the tangential points with the main towns, five thresholds are designed, identified both graphically in the paving and through the presence of pavilions and architectural-sculptural installations. Each of them represents a narrative stage, a 'chapter', emphasising the different landscape sequences and notable sites. The form of each pavilion is linked to a specific theme: the *past*, as an element to be discovered through the glimpses and stopping points of the labyrinth structure in Rosheim, starting point of the route; *water*, the subtle structuring element of the landscape, which is frequently encountered but is highlighted by the resting steps along the watercourse at the village of Boersch; the *cultivated land*, which opens up to view at the end of a forest tunnel in Leonardsau, framed by a high portal consisting of two large corten plates; the *journey*, symbolised by the former Ottrott station, where the signs left by the railway are embedded in the urbanised fabric, in a square reminding visitors and locals of past activities; finally, the theme of *luck*, which has given its nickname to the entire route - now known as 'portes bonheur' - represented by the sculptural belvedere positioned in the old Saint-Nabor quarry, where a process of renaturalisation is gradually restoring the mountain's productive wound, but the presence of the pavilion and the associated resting facilities allows visitors to experience the richness of the area, unfolding before their eyes in an impressive panoramic view of the landscape. In addition to these five main stations, the route is dotted with signposts and small rest facilities, which provide information on the visible and invisible features of the area and stimulate its slow rediscovery, made up of moments of contemplation and detours to nearby roads. The enhancement project, which has won several international awards, has above all been a success at the local level: community identity has been consolidated around this green infrastructure used both in daily life and to promote cultural activities and sustainable tourism systems. The Chemin des Carrières is a true project of local dynamism that embodies the ambition of its territory: to open up to the world, to allow safe and pleasant circulation in the heart of the communes, to promote a common history.

4 The inclusion of design in UNESCO tools for a new contextual valorisation methodology: the example of the Pearling Path project

The two cases described above show how an effective heritage valorisation system can be based on the design of the relationship with its context, working concretely on the structure of the territory and guiding its transformation.

At an institutional level the role of the project is still ignored by official UNESCO instruments, even if in practice it is present in some innovative practices of heritage management system, which can give useful indications for a more structured insertion of design/architectural tools. In fact, a design approach in relation to the UNESCO instruments previously analysed, in the definition of respect areas and to integrate the management systems of sites registered in the WHL (not only in the sphere of cultural landscapes, but more in general in the relationship between a cultural heritage and its context), would imply the structuring of a methodology that uses the tools of architecture both in the cognitive phase of the territory and in the planning of its transformations. An exemplary case in this regard is represented by the *Pearling Path*, a project with a strongly architectural imprint directly associated with the WHL inscription of the serial site "Pearling, testimony of an Island economy", which involves the entire historic centre of Muharraq, in Bahrain. Since the nomination dossier of 2009, the site has presented itself with innovative characteristics: the proposed Outstanding Universal Value integrates elements of the local material and immaterial culture, in the construction of a narrative of the place and its history that makes it more comparable to a cultural landscape than to an historic centre, in full agreement with the idea of heritage as a cultural practice linked to the local community. The narrative aspect is also dominant in the proposal of safeguard measures, which explicitly aims at the recovery and valorisation of specific elements within the urban fabric and the marine environment (*core zone*), connected by the shared fabric of the *buffer zone*, articulated in a dual sphere, which winds through the city and reconnects the pieces of a common narrative through public spaces and community life. The definition of these ambits is linked from the very start to a design intent, which is made explicit in the management plan and becomes operational following the obtaining of UNESCO recognition in 2012, through the study of a project for the curatorship and coordination of targeted transformative actions, planned to be implemented in different phases. These concern the core

zones, with restoration work on buildings of historical relevance, but above all the buffer zones, through projects for the urban redevelopment of public spaces and the construction of new facilities to benefit visitors and the local community - such as the Centre for Traditional Music - and are entrusted to designers with renowned experience in their respective fields. The project to revitalise the city, which after the heyday of its economy had been in an ever-increasing state of decay since the 1930s, is proving successful both in recovering a heritage in danger of oblivion and in triggering new dynamics of involvement of the inhabitants.

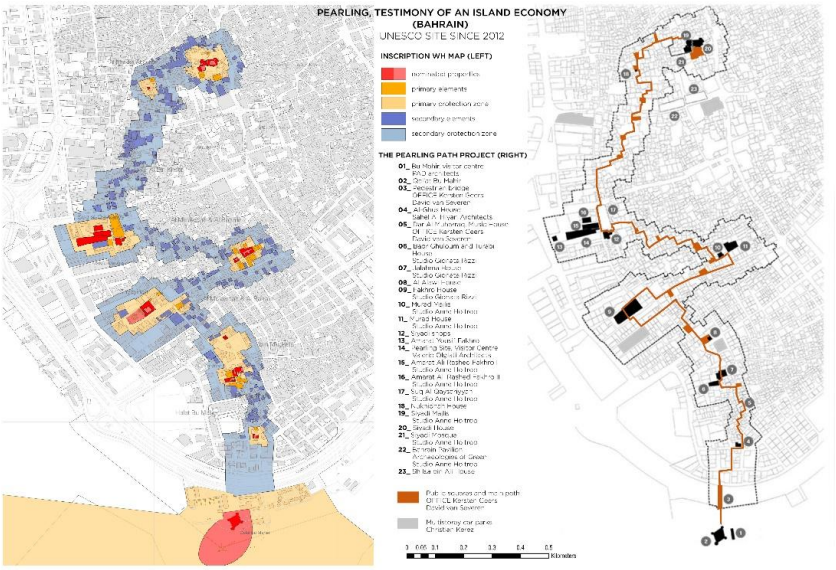

fig.2: mapping of core and buffer zone of the UNESCO site "Pearling, Testimony of an island economy (left) and design interventions program in the area (right). Elaboration of the author on official UNESCO maps

The particular political, regulatory and economic conditions of Bahrain, which is implementing a decisive, solidly financed cultural valorisation policy, are certainly factors that condition the implementation of such ambitious projects; however, the case of the Pearling Path is of particular relevance for an attempt at a programmatic definition of the contribution of design disciplines in the structuring and management of UNESCO sites in relation to their context.

5 Conclusions: a new key for heritage valorisation tools

The case of the Pearling Path helps clarifying the potential of a new design-based methodological approach: two application phases can be identified, which are interrelated and consequent. The first, which can be defined as a *cognitive framework*, is linked to the territorial knowledge project, through holistic and direct investigations that integrate historical, morphological and constraining research in order to concretely define the territorial assets that contribute to the definition of the value of the cultural heritage, and can positively or negatively influence its preservation and transmission. The aim of this first phase is the identification of the territorial areas of influence, which comes together in the definition of the *buffer zones* (at one or more levels); these are understood as complex and active territorial areas, subject to particular attention both from the point of view of control and of the promoted transformations. The buffer zones thus identified are in fact the preliminary cognitive step of a territorial development project based on the sharing of cultural heritage values and the construction of local identity. The second phase is therefore linked to the management of heritage over time, and is constituted as a multi-scalar and multi-phase project definable as *interpretation framework*, which defines in a coordinated and hierarchical manner the transformative actions to be promoted in the territory, whether of a public or private incentive nature. This type of strategic architectural design is concretely linked to the reality of places and constitutes the backbone of land management in relation to heritage, helping to reduce the dispersion of resources in fragmentary and extemporaneous projects, and also rooting intangible activities in the reality of places.

In an increasing focus on cultural heritage values, the change in the approaches to safeguarding and valorisation practices entails opening up to different fields and disciplines that look at the relationship with the contextual fabric as a resource. The institutional instruments implemented in the UNESCO framework acknowledge this evolution, but struggle to consider the physical transformations of places as a positive element in the construction of a relational fabric between heritage and territory; The introduction of a methodology that integrates the design tools with the management structure of the sites, involving both the definition of the buffer zones and the design of their transformation in a coordinated manner, can be effective in establishing a concrete dialogue between the sites registered in the WHL and the surrounding areas, unblocking the

stalemate mechanisms given by the purely constraining use of the buffer zones, which can thus become a place for the exchange of values with the local communities and an element for the construction of a shared identity, triggering a virtuous circle of mutual enhancement.

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Exploring the Current State and Future Research Agenda for Sustainability Knowledge Spillover in the Textile Industry

Heidi Salokangas*

Faculty of Engineering and Business – Master School
Turku University of Applied Sciences
Lemminkäisenkatu 30, 20520 Turku, Finland

Nina Helander

Faculty of Management and Business
Tampere University
Korkeakoulunkatu 7, 33720 Tampere, Finland

Heli Aramo-Immonen

Faculty of Engineering and Business – Master School
Turku University of Applied Sciences
Lemminkäisenkatu 30, 20520 Turku, Finland

Kaisa Sorsa

Faculty of Engineering and Business – Master School
Turku University of Applied Sciences
Lemminkäisenkatu 30, 20520 Turku, Finland

Krishna Venkitachalam

College of Business Administration (CBA)
Ajman University, Ajman, UAE

** Corresponding author*

Abstract

The EU Strategy for Sustainable and Circular Textiles outlines a comprehensive approach to promoting sustainability in the industry, including the use of recycled and renewable materials, circular business models, the uptake of sustainable innovations, and the reliability of sustainability knowledge. Literature suggests that promotion of sustainability knowledge spillover within the textile industry can have an impact on the overall textile

business in terms of social, financial, and environmental sustainability and its overall competitive advantage. This paper aims to provide a comprehensive overview of the current research on sustainability knowledge spillover in the textile industry. The research method is a systematic literature review of articles published in the leading KM journals.

Keywords – Knowledge Management, sustainability, textile industry, knowledge spillover

Paper type – Academic Research Paper

1 Introduction

In 2022, European Commission released the EU Strategy for Sustainable and Circular Textiles, which aims to promote sustainability in the fashion, textiles, clothing, leather, footwear, and carpet industries. This strategy emphasizes the importance of transparent communication, the promotion of circular business models, and the uptake of sustainable innovations. Furthermore, it outlines a comprehensive approach to promoting sustainability in the industry, including the use of recycled and renewable materials, circular business models, the uptake of sustainable innovations, and the reliability of sustainability knowledge. (EU Strategy for Sustainable and Circular Textiles, 2022)

According to the World Bank (2005), textile manufacturing was responsible for up to a fifth of industrial water pollution (Kant, 2012). In 2015, textile production contributed to 1.2 billion tons of CO2, which was "more than those of all international flights and maritime shipping combined". Since, the growth of the industry has been strong, alone in 2021 the "[g]lobal industry revenues grew 21 per cent year on year" (Amed et al., 2022). In terms of waste, it has been estimated that up to a fifth of materials are wasted during the clothing manufacturing process. (Ellen MacArthur Foundation, 2017) Furthermore, Europeans send 87 % of their clothes into landfills or post-use waste incinerated which equals 11 kg per person (The Impact of Textile Production and Waste on the Environment (Infographic) | News | European Parliament, 2020). Thirdly, Siegle (2011) writes that the textile industry employs 40 million employees worldwide, and the industry is known to have its challenge with "low wages and poor working conditions" (Bick et al., 2018).

Thus it is not a surprise that existing literature indicates that alone in the fashion industry, which is only one part of the overall textile industry (see Figure

1), "sustainability presents the biggest opportunity" (Amed et al., 2022; Amed et al., 2016).

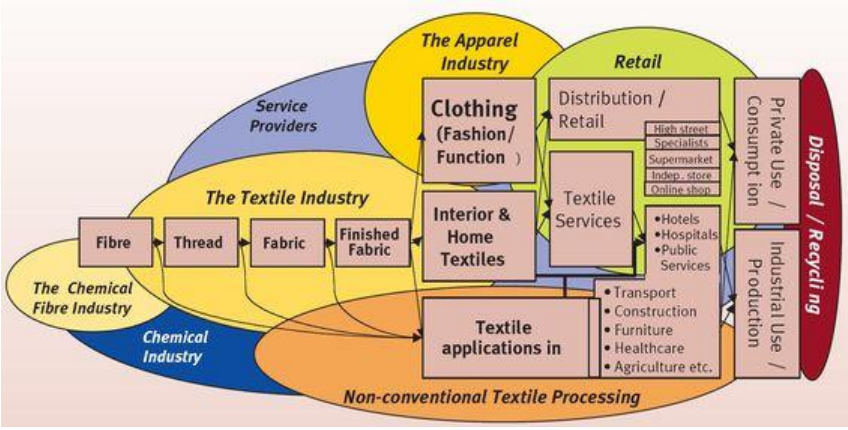

Figure 1: Textile production value chain and included businesses as presented by the Tex-Map project (adapted from Fontell & Heikkilä, 2017)

The preliminary findings on sustainability knowledge spillover in the textile industry show that knowledge management strategies and knowledge-based development can promote sustainability and competitiveness in the sector (Heisig et al., 2016; Kumar & Ganesh., 2011). Promotion of sustainability knowledge spillover within the textile industry can have an impact on the overall textile business in terms of social, financial, and environmental sustainability and its overall competitive advantage.

The paper aims to provide a comprehensive overview of the current research on sustainability knowledge spillover in the textile industry. The research question of this paper is: What is the state of the art of sustainability knowledge spillover in the textile industry among KM literature? The research method is a systematic literature review of articles published in the leading KM journals.

2 Background on Sustainable Development

The concept of sustainable development is defined by World Commission on Environment and Development (1987) in the so-called Brundtland Commission's report, Our Common Future, as a "development that meets the needs of the present without compromising the ability of future generations to meet their own

needs." One of the objectives of sustainable development is to balance economic growth with environmental and social concerns while eliminating poverty.

Desore & Narula (2018) suggest that sustainability in the textile industry is aligned with environmental sustainability. In practice for the company, sustainability may mean process engineering approaches like re-engineering wastewater systems to reduce water and energy consumption and adding up-to-date machinery and chemistry to the different process phases. In addition, companies may utilize recycled material as part of their production or use renewable energy sources . Secondly, from a business perspective, companies may enter new environmental business segments, launch new 100 % organic cotton products or redesign existing products to have more organic components, upcycle and have eco-labels as a marketing aid or use reusable packages . (Desore & Narula, 2018)

At the start of 1990s, the spillover theory was mentioned in the textile context within the KM discipline when Romer (1992) pointed out that the generation of big "(for example, how to make high-temperature superconductors)" and an enormous number of small ideas "(better ways to sew a shirt)" enables sustained economic growth. Coming to the concept of spillover, the core idea of spillover lies on causality, meaning that a specific action causes some other, not intended action or effect. Thus, spillover is something unintended and this is the starting point also in knowledge spillovers. For example, Breschi & Lissoni (2001) discuss the concept of localized knowledge spillovers and define them as knowledge externalities bounded in space. Furthermore, knowledge spillover refers to the unintentional transmission of knowledge to others beyond the intended ones. To be more specific in knowledge management terms, if knowledge is exchanged with the intended actors (person or organization), it is understood as knowledge transfer. Whereas any other knowledge that is exchanged outside the intended boundary, it could be argued as spillover. (Fallah & Ibrahim, 2004)

3 Methodology

We employed a systematic literature review (SLR) as a guiding framework to identify valid papers and provide an overview of sustainability knowledge spillover in the textile industry within the field of knowledge management. The use of SLR is selected to minimize potential researcher biases (Tranfield et al., 2003), while the selection of seven leading KM publications aimed to reduce

publication biases (Moher, 2009). According to Snyder (2019), SLR is a valuable methodology for gaining a comprehensive understanding of research questions, providing an audit trail, and ensuring the repeatability of the study. Also, Tranfield et al. (2003) highlight the significance of SLR as "a key tool" for managing the diversity of knowledge in academic research.

We performed SRL in two phases to map the state of the general literature in the sustainability knowledge spillover in the textile industry. The 1st phase consisted of scoping search of the literature of published papers in one of the leading KM journals to reveal what has already been studied on the topic within the KM discipline (ref. Atkinson & Cipriani, 2018), and the 2nd phase involved an in-depth systematic review of leading KM journals based on the (Serenko and Bontis, 2022) study of KM/IC journals ranking. In the 1st phase a researcher analyzed the papers and in the 2nd phase study investigator triangulation (Denzin & Lincoln 2000) among three researchers was used to analyze the papers to ensure the reliability of the findings.

In the 1st phase, we conducted a keyword search in the Journal of Knowledge Management using the keywords "sustainability textile knowledge" on September 6th, 2022 to ensure that textiles and sustainability are in the scope of the KM discipline. The search resulted in 32 articles, of which 17 were relevant after using the find command (ctrl F) to identify instances of the keywords "textile" and "sustainability" in the main text. An additional three articles were found during a keyword search on December 7th, and two were deemed relevant for the literature review. A second keyword search using the keywords "sustainable textile knowledge" on December 13th, 2022, resulted in 50 articles. After importing both ris-files into a reference management software program (Zotero) and removing duplicates, 23 articles remained. The find command was used to identify instances of the keywords "textile" and "sustainable" in the main text. We applied the practical screening criteria to include only the papers, which mentioned Textile industr* and Spillover*. Table 1. below outlines the resulting papers after applying the practical screening criteria.

Table 1. Papers containing sustainability/sustainable textile knowledge in the Journal of Knowledge Management 1999 – 2022

No.	Author	Title
1	(Brand, 1998)	Knowledge Management and Innovation at 3M
2	(Cardinal et al., 2001)	Knowledge codifiability, resources, and science-based innovation
3	(del Rosario González Ovalle et al., 2004)	A compilation of resources on knowledge cities and knowledge-based development
4	(Garcia, 2004)	Developing futures: a knowledge-based capital for Manchester
5	(Danskin et al., 2005)	Knowledge management as competitive advantage: lessons from the textile and apparel value chain
6	(Balestrin et al., 2008)	Knowledge creation in small-firm network
7	(Yigitcanlar et al., 2008)	Rising knowledge cities: the role of urban knowledge precincts
8	(Chawla & Joshi, 2010)	Knowledge management practices in Indian industries – a comparative study
9	(Belso-Martínez et al., 2011)	Clustering and internal resources: moderation and mediation effects
10	(Kumar & Ganesh, 2011)	Balancing knowledge strategy: codification and personalization during product development
11	(De Marchi & Grandinetti, 2013)	Knowledge strategies for environmental innovations: the case of Italian manufacturing firms
12	(Testa, 2013)	Knowledge transfer in vertical relationship: the case study of Val d'Agri oil district
13	(Tuamsuk et al., 2013)	Knowledge management model of community business: Thai OTOP Champions
14	(Yee-Loong Chong et al., 2014)	Can e-business adoption be influenced by knowledge management? An empirical analysis of Malaysian SMEs
15	(Heisig et al., 2016)	Knowledge management and business performance: global experts' views on future research needs
16	(Buenechea-Elberdin et al., 2018)	Knowledge management strategies, intellectual capital, and innovation performance: a comparison between high- and low-tech firms
17	(Rua et al., 2018)	Key drivers of SMEs export performance: the mediating effect of competitive advantage
18	(Shubham et al., 2018)	Institutional pressure and the implementation of corporate environment practices: examining the mediating role of absorptive capacity
19	(Anzola-Román et al., 2019)	Technological proximity and the intensity of collaboration along the innovation funnel: direct and joint effects on innovative performance
20	(Oliva et al., 2019)	Innovation in the main Brazilian business sectors: characteristics, types and comparison of innovation
21	(Li et al., 2019)	Search broadly or search narrowly? Role of knowledge search strategy in innovation performance
22	(Yadav et al., 2020)	Analysing enablers of knowledge management in improving logistics capabilities of Indian organisations: a TISM approach

23	(Shahzad et al., 2020)	Exploring the influence of knowledge management process on corporate sustainable performance through green innovation
24	(Chaurasia et al., 2020)	Open innovation for sustainability through creating shared value-role of knowledge management system, openness and organizational structure
25	(Gonzalez, 2021)	Effects of learning culture and teamwork context on team performance mediated by dynamic capability
26	(Haq, 2021)	Supply chain learning and organizational performance: evidence from Chinese manufacturing firms
27	(Zhang et al., 2021)	Knowledge spillover driven by institutions: evidence from the big science project in China
28	(Soares et al., 2022)	Creation of organizational knowledge through a model of standardization of production systems in the paper industry
29	(Bresciani et al., 2022)	The role of environmental management accounting and environmental knowledge management practices influence on environmental performance: mediated-moderated model
30	(Cordeiro et al., 2022)	Realizing dynamic capabilities and organizational knowledge in effective innovations: the capabilities typological map
31	(Martínez-Martínez et al., 2022)	Active listening to customers: eco-innovation through value co-creation in the textile industry
32	(Bolatan et al., 2022)	Unlocking the relationships between strategic planning, leadership and technology transfer competence: the mediating role of strategic quality management
33	(Wen & Wang, 2022)	Does knowledge structure matter? Key factors influencing formal and informal knowledge sharing in manufacturing

In the 2nd phase, to ensure a thorough sample of covering the most important papers in relation to our research question in the field of KM, we covered the following academic journals: Journal of Knowledge Management, Journal of Intellectual Capital, The Learning Organization, VINE Journal of Information and Knowledge Management Systems, The Journal of Knowledge Management Research and Practice, Knowledge and Process Management, International Journal of Knowledge Management. The time frame for the academic journal selection was the last ten years (2012 – 2022), which we used to ensure that articles are relevant and current.

We used search string ("circular economy" OR degrowth OR "environment* protection" OR "green economy" OR "green transition" OR "integrated production" OR "natural resources" OR "organic production") OR (sustain* OR cultural OR ecological OR economical OR economic OR social OR agriculture OR consumption OR "forest management" OR living OR tourism OR use OR development) AND "textile industry*" AND spillover* as the aim was to especially understand the concepts related sustainability and their intersections with the textile industry in the context of knowledge spillover. We selected the search

string so that the overall concept of sustainable development and its related concepts were covered, and therefore we built the search string based on the Finnish Thesaurus and Ontology Service Finto. We chose FINTO, since the overall concept of sustainable development and its related concepts have been created 25th of March 1992 and the Ontology has been regularly updated, the latest update is from the 18th of February, 2023. The Service is developed by the National Library of Finland, and then international users of the service include UNESCO and BARTOC. Therefore, we considered the search string current and valid. With the search string, 76 articles we identified related to this study all the results are documented in the spreadsheet.

We used a systematic approach to identify each search string keyword in the paper. We used the "ctrl+f" function to search for search string keywords within the text of each paper, and we logged the results into an Excel spreadsheet. We marked x into a spreadsheet when we found the keyword in the paper, and on occasions where the keyword was not found in the paper, we marked N/A. This way, we could identify the specific concepts related to sustainability based on the search string. We applied the practical screening criteria to include only the papers, which mentioned Textile industr* and Spillover*. Table 2 outlines the resulting papers.

Table 2. The overview of Papers containing Textile industr* and Spillover* in the leading KM journals 2012 – 2022.

No.	Author	Title	Publication
1	(Marques et al., 2021)	Technological transfer and spillovers within the RIS3 entrepreneurial ecosystems: a quadruple helix approach	Knowledge Management Research & Practice
2	(Zhang et al., 2021)	Knowledge spillover driven by institutions: evidence from the big science project in China	Journal of Knowledge Management
3	(Sun et al., 2022)	The contingent roles of market turbulence and organizational innovativeness on the relationships among interfirm trust, formal contracts, interfirm knowledge sharing and firm performance	Journal of Knowledge Management

4 Research findings

Based on the reviewed papers during the 1st phase, the preliminary findings suggested that sustainability knowledge spillover in the textile industry shows that knowledge management strategies and knowledge-based development can promote sustainability and competitiveness in the sector (Heisig et al., 2016, Kumar & Ganesh., 2011).

As the table above shows, we found a limited number of papers, totally there are three papers, which mention the textile industry* and spillover* and had a sustainability-related concept mentioned, the earliest paper is in 2021 and the latest is from 2022 (ahead-of-print). Considering our aim is to understand the sustainability knowledge spillover literature landscape, we compiled table 3 by the selection of papers based on the knowledge spillover type, sustainability concept and chosen research method.

Table 3. The overview of the paper knowledge spillover type, sustainability concept and research methodology applied.

	Knowledge Spillover	**Sustainability Concept**	**Research Method**
(Marques et al., 2021)	positive spillover effect	sustain*development	qualitative
(Zhang et al., 2021)	positive spillover effect	sustain*development	qualitative
(Sun et al., 2022)	negative spillover effect	not in content, referred to in references	qualitative and quantitative/mixed method

Marques et al. (2021) studied the implementation of smart specialization and technology transfer in a quadruple helix in Portugal. In this article, the textile industry is referred to as one of the university's collaborations partners, and one of the informants refers to Inditex as an example. The sustainability concept of the 'circular economy' is used as one of the suggestions to indicate collaboration possibilities between the society's actors and higher education. In addition, 'Sustainable development' is found in the references. In the article, the authors highlight the knowledge spillover perspective where the knowledge spillover is seen as a building block for innovations towards sustainable competitive advantage. (Marques et al. 2021; Ramadani et al., 2017). Furthermore, the authors suggest that regulations should be placed to encourage the knowledge spillover between higher education and SMEs to foster local economic growth, zero-waste

behavior and optimizations of resources (Davies et al., 2021; Dimitropoulos et al., 2019; Marques et al. 2021).

Zhang et al. (2021) explored "the knowledge spillover mechanism in big science projects" in China. The textiles were referred to as cite notes to mention that a specific city used to be well-known "for its wool textile industry". In this article, sustainability is seen as an outcome of the big science projects to help the government draw different policies and funding (Zhang et al., 2021).

Sun et al. (2022) explored trust and contract governance mechanisms and their influence on knowledge sharing in connection with company performance, market conditions and organizational innovativeness. I study data was also collected from the textiles/clothing industry among other industries. In the paper, sustainability is only referred to in the reference section. In the terms of knowledge spillover, the authors pointed out that knowledge spillover can have two effects on firms' performance it can either harm (negative spillover effect) or influence positively.

From the SLT review above, the key preliminary finding is that that there is a limited amount of literature available on sustainability knowledge spillover in the textile industry among knowledge management disciplines.

5 Discussion and conclusions

As knowledge spillover is seen as one of the contributors to innovation ability, we suggest that sustainable knowledge spillover research in the context of fashion, textiles, clothing, leather, footwear, and carpet industries may have a positive impact by fostering new eco-innovations leading to the long-term competitive advantages for the sector.

Regarding the practical/managerial implications: In general, a previous study showed that knowledge spillover has a favorable influence on businesses' innovation ability (Montoro-Sánchez et al., 2011). At the same time, European Commission (2012) promotes that eco-innovations are "[t]he key to Europe's future competitiveness", and the Commission expects that eco-innovations among other things decrease the expense and boost the businesses' image in the eyes of the consumers. Studies also suggest that businesses, which have implemented green practices seem to have greater profitability, better relationships with stakeholders, and lower overall costs (Wu et al. 2012; Baskaran et al., 2012; Caniato et al., 2012; Hansen and Schaltegger 2013).

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Legal and Regulatory Innovations: Systematic Literature Review

Kaisa Sorsa*

Faculty of Engineering and Business – Master School
Turku University of Applied Sciences
Lemminkäisenkatu 30, 20520 Turku, Finland

Heidi Salokangas

Faculty of Engineering and Business – Master School
Turku University of Applied Sciences
Lemminkäisenkatu 30, 20520 Turku, Finland

Salvatore Ammirato

Department of Mechanical, Energy, and Management Engineering
Università della Calabria
Via P.Bucci, 42\C, 87036 Rende (CS), Italy

Alberto Felicetti

Department of Mechanical, Energy, and Management Engineering
Università della Calabria
Via P.Bucci, 42\C, 87036 Rende (CS), Italy

Heli Aramo-Immonen

Faculty of Engineering and Business – Master School
Turku University of Applied Sciences
Lemminkäisenkatu 30, 20520 Turku, Finland

Nina Helander

Faculty of Management and Business
Tampere University
Korkeakoulunkatu 7, 33720 Tampere, Finland

* *Corresponding author*

Abstract

In this paper we explore: What are definitions for legal innovation and regulatory innovation? in the context of the whole lifecycle of regulation. We use systematic literature review (SLR) method. The lifecycle of regulation consists of law drafting, law implementation, monitoring, and sanction of law in act. Definitions of legal/regulatory innovations (LRIs) are interpreted and applied in the field of public regulation as well as private regulation. Our paper has two objectives:

- Provide a holistic account of the literature on legal/regulatory innovations based on current knowledge about a set of key research themes;
- Identifying an agenda addressing new research directions in this field of study.

We found out that only few writers in the selected articles clearly define, what do they mean with the terms legal or regulatory innovation. SLR analyses provided an overview of the topics of legal and regulatory innovations: Topic 1: LRIs in the context of Complex Adaptive Systems; Topic 2: LRIs for social welfare and Topic 3: LRIs in the different levels, networks of actors and phases of the regulatory life cycle.

LRIs develop in complex adaptive systems which means that there is a continuous relationship between legal system and society.

New kind of LRIs were discussed in the context of public and private regulation: Default design, Sandboxes and Nudge are possible tools of new governance approaches to regulation developed by governments. Process standards compared to traditional product standards are seen more innovative as they allow regulates develop most innovative way to comply the standards. Process-based standards and other standards developed by private actors have a lot to offer for the development of new LRIs. Regulatory knowledge is needed in the dynamic, complex society, in order to understand how LRIs can promote the change towards desired goals.

Keywords Legal innovation, regulatory innovation, transition management, sustainability, SLR

Paper type – Academic Research Paper

1 Introduction

In this paper, we explore with systematic literature review (SLR) method research questions: What are definitions for legal innovation and regulatory innovation? in the context of the whole lifecycle of regulation. The lifecycle of regulation consists of law drafting, law implementation, monitoring, and sanction of law in act. Definitions of legal/regulatory innovations are interpreted and applied in the field of public regulation as well as private regulation.

In order to explore the phenomena of legal/regulatory innovations we carried out a Systematic Literature Review, by analyzing a set of papers through a text

mining approach based on the Latent Dirichlet Allocation (LDA) in order to find what are the relevant topics in the investigated research domain (Denyer and Tranfield, 2009). This activity was performed through MySLR software (Ammirato et al., 2022). To our best knowledge, no systematic studies on the explored phenomena are present in literature, as such, our work aims to fill this gap, by having the following objectives:

- Provide a holistic account of the literature on legal/regulatory innovations based on current knowledge about a set of key research themes;
- dentifying an agenda addressing new research directions in this field of study.

2 Key definitions

Regulation in a wide sense is, the sustained and focused attempt to alter the behaviour of others according to standards or goals with the intention of producing a broadly identified outcome or outcomes, which may involve mechanisms of standard-setting, information-gathering and behaviour-modification (Black et al. 2005, 11.)

Law is defined to mean publicly-made regulation, incorporating both mandatory and enabling methods, which individual or collective private actors can specify and modify for their own needs. Regulation contains—especially from a European perspective— "the idea of control by a superior; it has a directive function" (Ogus 1994). According to Ogus (2009, p. 333) regulation refers to obligations imposed by public law designed to induce individuals and firms toward outcomes that they would not voluntarily reach, mainly enforced by public officials. Compliance is aided by deterrence or imposition of some sanction.

Rules and other regulatory measures can also be enacted and developed by private actors. Private rule-making is the process during which private actors use their regulative power both in areas where there is enabling legislation and where public law-making has not emerged or cannot operate due to constitutional limitations. Private regulation takes the form of codes of conduct, codes of ethics, codes of good practice, guidelines, and voluntary agreements. (Sorsa 2011).

In the literature regulatory innovation is defined to be the use of new solutions to address old problems, or new solutions to address 'new' or newly constructed problems, but not old solutions to address old problems (Black 2005, p.4). This

means that regulatory innovation is time and place specific; old measures in one country can be innovative in another country. According to Duffy (2007), "True innovation here means not any change (like a change in social values or a mere change in fashion) but rather a change that is an intellectual advance and is objectively better in accomplishing the purposes of the law".

Innovation of regulatory technique and diffusion of LRIs are two different things – they are innovations in the different place of the regulatory lifecycle (Fromond, Similä & Suvantola 2009, 4). Understanding, how legal innovations diffuse, is needed, in order to understand law's impact on society and the way society and law interact (Rubin (2015, 365).

3 Methodology

3.1 Paper location and selection

We conducted an SLR to provide an overview of scientific literature on the topic of legal and regulatory innovation. In line with the SLR principles provided by Tranfield, Denyer, and Smart (2003), the research protocol we adopted consists of three main steps: paper location and selection, paper analysis, and results presentation/analysis.

3.1.1 Search string

Our research is aimed at analyzing works related to regulatory innovation or legal innovation. Therefore the search string was structured so that the results contained papers with at least one term between "legal innovation" or "regulatory innovation" in the title, abstract, and keywords. We selected Elsevier's Scopus and Web of Science (WoS) as scientific databases in which to perform our search which are widely recognized as relevant and comprehensive scientific databases in the managerial field of study (Bhimani, Mention, & Barlatier, 2019).

We performed the search in January 2023, finding 556 papers from Scopus and 323 papers from WoS. The following selection criteria were then introduced to ensure the quality and relevance of the papers to be analyzed:

- papers are written in English;
- papers are published in scientific journals;

- papers are indexed at least in one of the following subject areas: Business, Management, and Accounting; Social Sciences; Engineering; Economics, Econometrics, and Finance; and Decision Sciences.

At the end of this step, 406 journal articles from Scopus and 276 articles from WoS were extracted. We then merged results from the two scientific databases, finding 521 unique papers. We manually analyzed the title and abstract of each paper to decide whether they matched the focus of our study. At the end of this process, a total of 448 papers to be analyzed has been found.

3.1.2. Paper analysis

We utilized a text-mining approach based on latent Dirichlet allocation (LDA) to reveal the research topics in the context of legal and regulatory innovation. The LDA technique gives as output k sets of relevant keywords (where each set represents a topic) and the document-term matrix, i.e. a matrix describing how much each paper is devoted to a specific topic (i.e. topic proportion).

To perform this activity, we utilized MySLR software (Ammirato, Felicetti, Ròganо, Linzalone, & Corvello, 2022), which is a semi-automated tool supporting researchers in performing SLRs.

Following Blei (2012), we selected k, i.e. the number of topics to be extracted, by evaluating multiple LDA results with k ranging from 2 to 20. We chose k and the LDA algorithm to guarantee a sufficiently high value of topic coherence (Chen & Liu, 2014) and, at the same time, a simple interpretation of the results for a human reader. The most meaningful set of topics was achieved with k = 3.

3.1.3 Results synthesis

Three topics were identified through the LDA procedure, each of which is related to a different perspective: Legal and regulatory innovations in the context of Complex Adaptive Systems for topic 1; Legal and regulatory innovations for social welfare for topic 2; and Legal and regulatory innovations (e.g. nudge) in the different levels and networks of actors and phases of the regulatory life cycle for topic 3.

The LDA procedure assigned 151 papers to topic 110 papers to topic 2, and 187 papers to topic 3. In fig 1. the intertopic distance map, a visualization of the topics in a two-dimensional space, is provided. The area of these topic circles is proportional to the number of words that belong to each topic across the dictionary. The map would seem to suggest a strong polarization of the

documents on the individual topics; in other words, the papers that are assigned to a topic have little to do with the other topics.

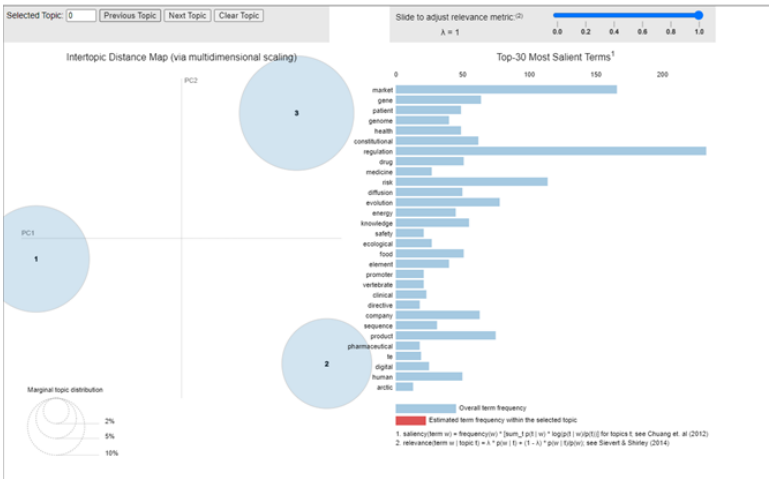

Fig 1. The inter topic distance map with three topics.

What emerges when analyzing the evolution of the publications within topics over time (see Figure 2) is that the number of papers is rapidly increasing, both overall and in each topic; therefore, all the topics represent both present and future research themes.

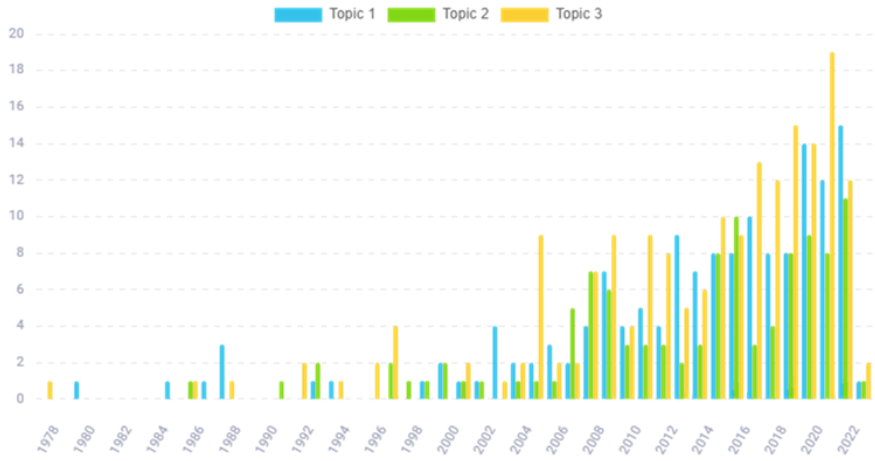

Fig. 2: distribution of the sampled papers per year and per topic

In what follows, the three topics identified through the LDA procedure are presented and discussed.

Topic 1: LRIs in the context of Complex Adaptive Systems (CAS)

Topic one is combination of articles from two different areas: those focusing on legal doctrine and those focusing on regulatory innovation in the biology. In the latter, regulatory innovation words have different meaning compared to what we were expecting. 'Regulatory innovation' is understood in genome evolution context as an innovation which emerges regularly.

Articles representing legal doctrine focus on the field of international trade law, criminal law and intellectual property law all representing the field of complex, adaptive systems (CAS), in which law coevolves with other complex social and natural systems as well as how legal systems grow and sustain themselves (Morin, Paywelyn and Hollway 2017, 378). Innovations always derive from existing elements. Similar to biological reproduction and genetic recombination, social innovations are the product of recombining existing ideas. Applied to trade agreements negotiations, trade negotiators invent new legal norms by combining or refining existing norms (Morin et al. 2017, 378).

Two other examples represent criminal law: Beckett and Herbert (2008) describe new social control techniques, which fuse criminal and civil legal authority and are touted as 'alternatives' to arrest and incarceration. Examples come from U.S. Suk's article (2006) discusses LRIs in the domestic violence enforcement context. Traditionally home was considered as private space in which the criminal law did not enter. Suk discusses the protection order that excludes a person accused of domestic violence from the home.

Rubin's (2015) article clarifies the diffusion of LRIs. She distinguishes between the prison's innovation and early adoption in the South and frontier states in U.S. LRI was driven by the desire to conform to increasingly widespread practices. Her study illustrates the importance of distinguishing between the motivations that initiate criminal law innovations and the varied reasons behind their diffusion.

Duffy's (2007) article analysed the development of patent law. "True innovation here means not any change (like a change in social values or a mere change in fashion) but rather a change that is an intellectual advance and is objectively better in accomplishing the purposes of the law". Patentable inventions must be new, useful, and *nonobvious*. Nonobvious criteria was a real innovation as it is most important in the context where technology and society change rapidly. (Duffy 2007, 2, 70-71; See also Alaassar et al. 2020).

In the CAS social interactions are continuous. Alaassar, Mention and Aas (2020) focus on the social interaction element. Their findings indicate many positive issues which regulator-regulatees' social interactions increase: the legitimacy, risk management capabilities, and knowledge of regulatory frameworks. These interactions and knowledge exchange are promoted in the context of regulatory sandboxes between regulators and market participants by increasing regulators' understanding of regulatory constraints and potential risks in enabling technologies. Regulators will be better informed of regulatees' support needs. Therefore they can offer them early access to regulatory innovations.

The second part of topic 1 describes 'regulatory innovation' in the biological evolution context. However, regulatory innovation was used in the following articles in genome evolution context as an innovation which emerges regularly: Lowe, Craig B., Clarke, Julia A. Baker, Allan J., Haussler, David and Edward, Scott V. (2015); Lowe, CB Kellis, M Siepel, A Raney, BJ Clamp, M Salama, SR Kingsley, DM Lindblad-Toh, K Haussler, D (2011); Gerdes, P Richardson, SR Mager, DL Faulkner, GJ (2016); de Mendoza, A Hatleberg, WL Pang, K Leininger, S Bogdanovic, O Pflueger, J Buckberry, S Technau, U Hejnol, A Adamska, M Degnan, BM Degnan, SM Lister, R (2019) and Carelli, FN Liechti, A Halbert, J Warnefors, M Kaessmann, H (2018).

Topic 2: LRIs for social welfare.

This topic has articles from law journals from researchers, who present the field of legal or policy research.

Burris (2008) investigates how the human subjects who are target of the research should be protected and how their rights are protected. He analyses different legal instruments and strategies and evolution of them in U.S. Burris argues: "the system was in key respects a departure from traditional top-down regulation and hard law, but through flaws in its mission, structure and implementation, has ended up reproducing the sort of self-referential legalism."

Faulkner and Poort (2017) discuss what kind of strategies of law-making - commensuration, an analogical legislative strategy, including new provisions in an existing legal framework or development of new legal frameworks – are needed and what kind of knowledge should be used in law-making process. They specifically addressed the question of adaptation of existing regulatory frameworks in the face of innovation in biotechnologies, and specifically the role of expert knowledge. They demonstrated in their article how different modes of regulatory knowledge can shape regulatory innovations either by maintenance of

regimes through commensuration and stretching, or through differentiation and separation creating new frameworks practices. Article focuses to the beginning of the regulatory lifecycle, to the law-making and implementation. It sheds light on to a broader understanding of the concept of regulatory knowledge and its role in the construction and re-construction of law: Regulatory knowledge encompasses more than scientific knowledge only. Their analyses is based on combination of a legal and Science and Technology Studies (STS) perspectives. They point out to the need to use expert committees and the workings of other expert knowledge actors as vehicles or channels of regulatory knowledge.

Need for the change of regulatory instruments has risen as a consequence of dynamic change in the different parts of the social life. Van Alstine (2002) has found out that the progress in the law has come to be characterized more by large legislative initiatives than by slow accretions of common law experience[1]. His article emphasized the role of transaction costs analysis for lawmakers. Available drafting and implementation techniques can mitigate transitional friction before it arises and facilitate both the acceptance and effectiveness of legal reforms. For achieving the ultimate goal of regulations - how a proposed change can correct some perceived problem or otherwise improve the substance of the law (Id, p. 853) - and finally to improve social welfare, it is useful to consider also the costs of change in legal environment. A minimal and flexible enabling approach over comprehensive regulation (Id, p. 859; 869) should be preferred.

In addition to transaction costs, the limits of human rationality (Amir & Lobel 2008 and Burgess 2012) and should be taken into account in the law-making. The nudges are designed to improve individual welfare, well-being, and happiness in accordance with an individual's own preferences. The law maker's role is to offer defaults by simply facilitating a fuller expression of individuals' desires by choosing welfare-enhancing defaults rather than remaining neglectfully default neutral. Nudging is based on the behavioral economics. Burgess argues that nudging provides the modern and cheaper means of dealing with social problems to policy maker with a fresh and practical perspective on a range of problems in society (Burgess 2012, 5; see also Van Alstine 2002).

[1] *He mentions as examples the fields of law which steadily gained momentum for transition throughout the twentieth century, matters as diverse as labor relations, securities trading, racial and gender discrimination, consumer protection, and environmental rights were removed from the province of contract, tort, and property law and newly regulated by public legislation (Van Alstine 2002, 805)*

Camacho's (2007) discusses LRIs in the context of Endangered Species Act's ("ESA") Habitat Conservation Plan ("HCP") program. According to Camacho, the HCP plan was the earliest of a number of experimental innovations, which transformed administrative law from its traditionally static and inflexible "command-and-control" regulatory model into a negotiated process that balances public goals through both collaborative and adaptive decision-making. Fromond, Similä & Suvantola (2009) highlights the same issue in the biodiversity context.

Robinson's (2016) article brings a new perspective on social welfare topic discussing how technological innovation and regulatory innovation interacted and (see also Faulkner and Poort 2017) and enabled the pregnancy tests to bring home.

Topic 3: LRIs (e.g. nudge) in the different levels and networks of actors and phases of the regulatory life cycle.

Topic three is presented in several international journals of management, economics and policy.

Chaisse (2012) discusses the time when EU Member States ratified the Treaty of Lisbon, which amended the Treaty on European Union and the Treaty establishing the European Community. By this ratification EU acquired a wide legal competence for external economic matters extending the scope of external trade policy on issues of investment. Chaisse considers these changes as "essential innovations in EU international treaty-making powers, both on the international stage and in the EU bilateral relations, are significant", (Chaisse 2012, 52). By extending 'trade' policy to include investment changed the conditions of future negotiations between EU and other countries: Any regulatory innovation in the EU policy, may systematically affect regional and global Foreign Direct Investment flows (Chaisse 2012, 52). Alschner & Skougarevskiy (2016,) also investigated LRIs on global level analysing 2100 international investment agreements using content analysis methods. They were able to trace consistency and legal innovation in national treaty networks on the country-level.

Simmons (2001) and Flannery and Rangan's (2004) discuss harmonization of laws as a LRI in the international financial markets focusing on the interactions between a dominant "regulatory innovator" and the rest of the financial world. Explanations for how harmonization unfolds fall into two dimensions: (1) the incentives other regulators face to emulate or diverge from the regulatory innovation of the dominant financial center, and (2) the nature and extent of the

externalities produced by this reaction, as experienced in or anticipated by the dominant center (Simmons 2001).

From financial world to food industry, Lee's (2009) article focuses on collective action and policy content diffusion in the field of organic food industry in U.S. Lee (2009) investigated how local and federated certification organizations, which he calls Standards Based Certification Organizations (SBCO), within a state, are associated with policy outcomes. Three important policy outcomes were found: content innovation, content variation, and content elaboration. (Lee 2009, 1251). Lee's article aims to fill the research gap, how public and private regulation interacts in the legal innovation diffusion.

Unnevehr's and Jensen's article (1996) about Hazard Analysis Critical Control Point (HACCP) system is also from food industry and self-regulation. HACCP was a new approach for food safety, which relies on science-based risk assessment and prevention rather than on detection of hazards. Therefore, it is considered as a regulatory innovation in the food safety regulation. Another connecting issue with these two articles is that both discuss the relationship of private regulation and instruments created by private sector actors, either by companies or non-governmental organisations, and relationship of these regulatory instruments with the state-made-laws.

Pomeraz et al. (2009) discuss different regulatory innovations to addres obesity. Obesity is a huge problem in U.S. but as well in other countries. Pomeraz et al. (2009, 187-197) analyse different regulatory options for reducing risks for obesity. Considering performance-based regulation (PBR) as an alternative to typical regulatory actions, sounds most interesting approach. Traditional "command and control" regulation tells businesses what to do, whereas PBR tells businesses what to achieve but leaves it to them to get there. Callard's and Collishaw's article (2013) also discuss health issues from tobacco industry viewpoint. tobacco industry on "Supply-side options for an endgame for the tobacco industry". They discuss six different approaches to regulate tobacco markets in order to reduce harms for health. Proposals differ in two way: One difference is whether those who supply tobacco should be set accountable primarily for their achievement of financial or health goal. Another different regulatory approach to use input- or outcome-based regulation. Input-based regulation assumes that if enterprises make the ordered behavioural changes, then improved public health performances (Sugarman 2009,) will follow. Outcome-based regulation instead

would mean that tobacco suppliers should meet the regulatory objectives, such as a reduction in overall tobacco use.

Under topic three a lot of discussion was focused on different regulatory tools and strategies.

4 Conclusions

We found a lack of clear definitions for legal and regulatory innovations. The articles analysed in this paper cover broad variety of issues under the umbrella concept 'legal and regulatory innovation'. One connecting issue between topics was the idea of evolution of law and regulations in the complex adaptive system (Topic 1); as the surrounding society evolves, laws and regulations need to evolve as well. Our SLR tool had selected also articles on the field of biology, from where the term complex adaptive systems come from and also in cell biology, regular evolution is central. The articles discussing cell biology does not directly answer the question of legal innovation, but perhaps some analogy can be explored, as has been done with the term ecosystem (a term borrowed from biology and the natural sciences to the social sciences).

LRIs for social welfare -topic (Topic 2) focused on strategies of law, specifically how different modes of regulatory knowledge can shape regulatory innovations. Different regulatory instruments and strategies were discussed as well. LRIs in the different levels and networks of actors and phases of the regulatory life cycle (Topic 3) covered roles and issues emerging in global and local networks.

New innovative regulative strategies and tools like default design, sandboxes and nudge were discussed as possible tools of new governance approaches to regulation. Process standards compared to traditional product standards were seen more innovative as they allow regulates develop most innovative way to comply the standards.

Further research is needed in the area of legal innovations and knowledge management research: We found out that public law-makers do not have all the expertise needed e.g. for drafting law in the context of the fast changing technology, they need to have knowledge exchange with the industry representatives which may take place e.g. by actively networking with them. Public law-makers may also deliver law-making powers to industry and actors of civil society (self- and private regulation) or combine public- and private regulation (co-regulation). Understanding the system of implementation and

diffusion of LRIs need active exchange of knowledge between the regulator and regulates – these could be topics for research in future.

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Green Ports: Innovation Adopters or Innovation Developers? An Explorative Analysis through the Lens of Innovation Ecosystems

Marco Ferretti

Department of Management and Quantitative Studies,
Parthenope University of Naples
Via Generale Parisi, 13, 80131, Naples, Italy

Marcello Risitano

Department of Management and Quantitative Studies,
Parthenope University of Naples
Via Generale Parisi, 13, 80131, Naples, Italy

Maria Cristina Pietronudo*

Department of Management and Quantitative Studies,
Parthenope University of Naples
Via Generale Parisi, 13, 80131, Naples, Italy

Lina Öztürk

Department of Management and Quantitative Studies,
Parthenope University of Naples
Via Generale Parisi, 13, 80131, Naples, Italy

** Corresponding author*

Abstract

Global warming and resource depletion lead ports worldwide to define new strategies for reducing their environmental impacts. The paper offers an explorative analysis of three of Europe's largest and most polluted ports - Rotterdam, Antwerp, and Hamburg - describing how those ports address the sustainable challenge. Particularly, the analysis is beneficial to decline a recurrent concept, i.e., green port. The concept has been developed to increase environmental awareness and refers to a set of actions describing how the port balances the ecological footprint by economic benefits. Key actions to be sustainable often are mainly attributable to green technology adoption. Instead, the paper focuses on how ports act to be green. Is a green port a port that adopts green solutions for improving operational performance, or does it develop green solutions and guide the green strategy

with and for the entire local area? Results show that ports, in addition to adopting intelligent and digital solutions that improve ports' activities, they act as innovation hubs, building an innovation ecosystem that leads their green transition.

Keywords – Green ports, ports, sustainability, innovation ecosystem, innovation

Paper type – Academic Research Paper

1 Introduction

A green port results from a sustainable long-term strategy adopted by an entire port infrastructure, therefore, by the set of actors involved in port activities (Chang and Wang 2012; Ng et al. 2013; Li et al. 2011). The strategy aims to realize the development of sustainable port infrastructure focused on reducing negative environmental impacts (Pavlic et al. 2014). A green port is a valuable strategy, as ports must counter the adverse effects of pollution from the ship and cargo handling operations, congestion from using the hinterland transport network, and the negative effects of infrastructure developments (Lam and Van de Voorde 2012). Due to the emission control policy, ports must find a way to adapt and modernize port facilities; otherwise, they will lose their cargo, business volume and competitive position in the market. For instance, during shipping, ports operators emit pollutants such as CO2, SO2, and NO2, to reduce their value new advanced technology should be applied to transport equipment to increase fuel efficiency and reduce fuel consumption (Zhen, Zhuge and Wang 2020) on the condition that also new investment in technology and modernization must comply with the new "green" standards. Green technology represents the core tool for implementing ports' sustainable solutions. The more the port adopts technology labeled as green, the more it is aligned with environmental practices, regulations and recognized as green. However, green technology is not a magic bullet to transform a port into a green port. Technologies should be integrated with the local territory, adopted by stakeholders involved, and sometimes ad hoc developed since they affect the environment in and out of the ports' boundaries. In this term, adopting a sustainable strategy means knowing how to involve and engage a wide stakeholder network (industries, production, markets, citizens, and public authority). A green port is not only a deal of port authority and users that should "develop and operate proactively and responsibly, based on the economic green growth strategy" (European Commission, 2014; Twrdy and Zanne, 2020) it

should involve as many stakeholders as possible. Acciaro (2015) offers an avant-garde definition of green ports, integrated with a much more systemic view of ports: "green ports are those ports engaging in the proactive development, implementation, and monitoring of practices aiming at reducing the environmental impacts of the port at local, regional and global levels beyond regulatory compliance. They engage in innovation and research intending to balance environmental challenges with economic performance". This definition is not far from the view of ports as ecosystems. More and more academic contributions look in fact, at the port no longer as a silos infrastructure but as a sort of system well integrated with the surrounding environment that acts as a link among the social, economic, environmental, and spatial matrix of a region (Chen et al. 2010; Jansen et al. 2021). According to Bichou (2009), a port acts as an economic strategist since it participates in regional economic policy and planning initiatives in the region; it creates links among the social, economic, and environmental of a region, and actively engages and provides the rationale for other local stakeholders to contribute to regional development efforts. Verhoeven (2010) also stresses the port's ability to augment regional opportunity in terms of innovation, technology, and idea, considering the port an enabler of economic dynamism. In this way, considering modern environmental and digital transition challenges, the port might be a lighthouse for local innovation development and not just an adopter. More precisely, recent papers refer to innovation ecosystem concepts to explain how ports develop digital systems to exchange information and knowledge (Kapkaeva et al. 2021; Gerlitz and Meyer 2021) or facilitate start-up creation (Witte et al. 2018). What has been theorized, suggests that rather than adopting green technology and green practices ports may be fully engaged in the sustainable mission creating an innovation ecosystem around sustainability. To test this hypothesis, we conduct an explorative analysis investigating three of Europe's ten most polluting ports (Rotterdam, Antwerp, Hamburg) according to the T&E (2022), analyzing how they react to be green. Our research questions are how do ports address the sustainability challenges? How are they engaged in green solutions: do they adopt or develop green innovation? A multiple case study methodology (Yin, 2009) supports our purpose. We plan to obtain primary data through interviews with ports and local stakeholders; however, currently, we collect secondary data through the official websites of ports, articles, and papers in academic databases and social media such as youtube and Twitter. Preliminary results confirm ports may act as green port ecosystems, developing green

innovation to address the sustainability challenges. They play the role of innovation hubs that lead the sustainable transition of the local area and their global networks.

This paper provides an examination of green ports adopting the lens of the innovation ecosystem. It discusses best practices that may be extended to other traditional industries that are forced to be engaged in sustainability, illustrating how they can do and which benefits gain in adopting the innovation ecosystem approaches. Furthermore, the paper enlarges the ecosystem perspective in evaluating the sustainability behaviors applied by networks of organizations.

2 Theoretical Background

2.1 Green Ports

With the development of environmental legislation accompanied by increased public awareness of environmental issues such as global warming and resource depletion, the port's sustainability concept (Woo et al., 2018) is becoming more critical. The main reason the greening of the maritime transport sector and ports has a vital impact on the environment is that more than 80% of global trade volume is carried out by sea (UNCTAD, 2021). In addition to being the center of an important economic activity, ports attract attention due to their environmental impacts, and new strategies are developing to reduce these environmental impacts. These vital requirements have led to the emergence of the "green port" concept. Thus, the “green port” concept was developed to increase environmental awareness. When the idea of green port first emerged, it was defined as "a new ideology for the sustainable development of the port sector and referred only to the ports themselves, which balance their environmental footprint with economic benefits" (Żukowska, 2020). Subsequently, the organic combination of port development, resource utilization, and environmental protection, the green port began to refer to the port, which is characterized by a healthy ecological environment, reasonable use of resources, low energy consumption, and low pollution (Wan et al. 2018; Chen, 2009). Therefore, with all these definitions and concepts, it can be deduced that the roots of the green port concept are based on the triple bottom line principle, which includes social, economic, and environmental goals from a microeconomic standpoint (Elkington,1997). By its broadest definition, “green ports' can be defined as ports concerned with the

proactive development, implementation, and monitoring of practices aimed at reducing the environmental impacts of the port at local, regional, and global levels (Acciaro, 2015). This definition states that ports can be associated with ecosystems. Haralambides stated (1997) that a port provides a vibrant networking platform for regional development where efforts to sprout innovation, cluster formation, community engagement, environmental protection, and social capital increase, contributing to regional and national economies (Sakalayen, Chen, and Cahoon, 2017). In addition to environmental issues, the world's ports have to cope with technological, economic, and social problems and developments (Ravesteijn, Liu and Yan, 2015). Ports are inherently complex systems that require integrating and balancing technological, environmental, economic, institutional, and political considerations to achieve desired goals and meet many community needs (Abood, 2007). Therefore, it is inevitable to include all stakeholders of the ecosystem. It has been determined that different approaches have been used to analyze green ports in the literature. In the past, port development and operations took a regulatory-oriented approach. However, today, ever-increasing growth trends have raised concerns about declining consumption of resources, rising costs, and environmental and quality of life impacts. These concerns have required a more holistic approach and adaptive management built around a self-sustainability framework (Abood, 2007). Abood (2007) proposed a sustainable green port development and operations method. LEED (Leadership in Energy and Environmental Design) covers six categories; Sustainable Site, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, and Innovation. If a project scores up to 26 (category scores range from 5-17) is certified. In another study, green ports were categorized into resource management, environmental construction, and environmental quality. The former includes material selection, waste management, water resources, energy use, and transportation. At the same time, the latter covers environmental quality in ports, carbon dioxide emissions, water quality, land use, and ecological management (Maritz, Shieh, and Yeh, 2014). The researcher used an analytic hierarchy process for crucial success factors in Green Port. A hierarchy process performed with the geometric mean of relative importance between paired elements presented the consistency ratio revealing the consistency of the expert's decision. According to these metrics, the focus on being green is on solutions and technology that enable port to reduce its impact on the environment and not on how it reaches these goals regarding network and strategies. Furthermore, the attention is on

the responsibility of the green strategy and consequently of green performance is to port authorities that design, develop and monitor the sustainable plan (Lirn, Jim Wu and Chen, 2013), neglecting the behaviors of other actors.

2.2 Port as innovation ecosystems

During the last two decades scholars are looking at the port no longer as a silos infrastructure but as a sort of system well integrated with the surrounding environment that acts as a link among the social, economic, environmental, and spatial matrix of a region (Chen et al. 2010; Jansen et al. 2021). According to Bichou (2009), a port acts as an economic strategist since it participates in regional economic policy and planning initiatives in a region. It creates links among an area's social, economic, and environmental and actively engages and provides the rationale for other local stakeholders to contribute to regional development efforts. Verhoeven (2010) also stresses the port's ability to augment regional opportunity in terms of innovation, technology, and idea, considering the port an enabler of economic dynamism. According to Acciaro (2015), ports are engaged in innovation and research to balance environmental challenges with financial performance. Recent papers refer to ecosystem concepts to explain how ports should change how to collaborate and involve stakeholders to cause economic and environmental benefits for all actors involved and for the local area (Carpenter and Lozano, 2020). An ecosystem creates, integrates, and expands the value involving different stakeholders. The broader involvement ensures the inclusion of several dimensions, such as environmental, technological, legal, economic, governance, and social, enabling the ensemble of actors to address interdisciplinary issues and solve problems (Audretsch et al., 2019). Since ports are called upon to manage multiple and interdisciplinary issues to address sustainability challenges, the ecosystem approach may help them adopt a wider vision, align different economic agents (ports and their hinterlands), and impact the local area (Gerlitz and Meyer, 2021). Literature that merges the ecosystems approach with ports management proposes different ecosystems; each has the purpose of bringing together actors as well as information and knowledge to reach the port's sustainable goal. De Langen, Sornn-Friese, and Hallworth (2020) suggest the business ecosystem configuration. They propose a view of "*ports as localized business ecosystems in which individual companies strongly depend on the development of the ecosystem as a whol*e." Their idea of the ecosystem is

focused on creating customer value and involving all actors involved in delivering a specific product or services linked to the port's activities - cargo handling, ships consignment, passenger transport, stowing, and dredging. Gerlitz and Meyer (2021) propose a service ecosystem configuration. They suggest ports (mainly small and medium ports) should have service-centric offers to lead the environmental and digital transition. Ports should systematize the port's network resources and satisfy the multilevel needs of their customers. Clients that are at the same time resource providers refer to four domains: institutional, technological, social-environment, and market; therefore, those clients may require services related to norms and code of conduct, technology, environmental monitoring, and access to investment. These listed are an example of a set of services offered by a port service ecosystem that enables the development of a coordinated port community. Kapkaeva et al. (2021) describe the port of Hamburg as a (maritime) integrated system service supported by an IT and digital system that enables the transparent exchange of information between all stakeholders in the supply chain. The ecosystem concept expressed by Kapkaeva et al. (2021) is closer to the digital ecosystem since the authors focus on a digital platform for exchanging information between agents involved in the port supply chain. The platform aims to create a network of actors for a safe, efficient, and sustainable door-to-door supply chain. Witte et al. (2018) envision port as an innovative and entrepreneurial ecosystem. The interaction among stakeholders is not based on industry relationships but on cooperation between port and city. The authors explore the conditions for successful collaboration between the port and city by looking at the potential of start-ups and innovation ecosystems in port cities. They neglect the sustainability purpose of ports but discuss the innovation opportunity that ports may seize if they integrate innovation start-up into their network.

2.3 Analytical framework

The literature on green port and ports as ecosystems suggests that ports may follow two approaches to be a green port: adopting green technology and green practices within operational activities and/or being involved in the co-development and co-diffusion of sustainable innovation to apply in their own activities and in with o all the port stakeholders comprehended stakeholders of local port area (ecosystems actors). The last approach transforms a port into a

green innovation ecosystem. Drawing from the same literature, we propose a framework to analyze the port strategy toward sustainability. We identify three units of analysis: a) the port intended as a port authority, b)the port supply chain, c) the city and the hinterland. The coherence and the integration of sustainable purposes at the three levels confirm the ecosystem nature of the port. The objectives of their linkages may establish their common innovation purpose. To comprehend the role of the port and its key actors in adopting or developing innovations, we identify three dimensions for the analysis: operational, organizational, and strategic. The operational dimension identifies for each level green solutions implemented or developed; the organizational dimension describes how resources are allocated and organized to implement the sustainable strategy (e.g., green department or green manager); and the strategic level identifies sustainable plans and objectives fixed by the top (e.g., sustainable report, sustainable strategic plan). The more dimensions are integrated at all three levels, the more the port and its network behaviors as an ecosystem. The table describes in detail the subdimensions for each level of analysis.

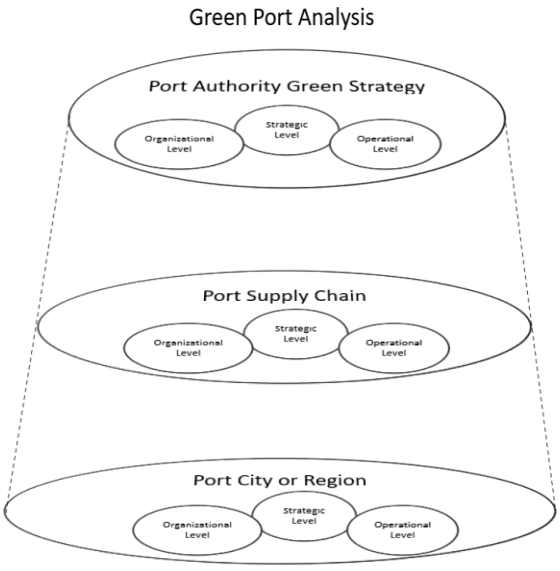

Figure 1. The analytical framework

3 Methodology

We conduct multiple case study methodologies to explore how ports address sustainability challenges (Yin, 2009). The paper intends to observe replications across the cases to investigate the same phenomena concerning the adoption or development of innovation (Patnaik and Pandey, 2019). Multiple case studies are characterized by different design situations (e.g., different context settings) where the same units of analysis are examined. According to Yin's (2009) theorization, we conduct a descriptive case study design since we present a complete description of a phenomenon within its context. The goal set by the researcher is to describe the data as they occur. Shanahan, Jones, and McBeth (2018) suggest that descriptive case studies may be in a narrative form, we offer narratives covering each of the cases singly and then a cross-case analysis is shown in the discussion section (Stake, 2013).

The study aims to guide the selection of cases. We select the three most polluted North European ports to describe how ports address the sustainable challenges and if they co-develop innovation within the port ecosystems or adopt green technology. Selected cases are Rotterdam, Antwerp, and Hamburg. Collected data derived from multiple sources of information, i.e., observations, indirect interviews, audiovisual material and documents, and official reports. Various sources of information support the triangulation process and increase the quality of the findings (Eisenhardt, 1989; Yin, 2009).

4 Results and Discussions

The Port of Rotterdam is Europe's largest seaport and most polluted port. It emits 13.7 million tonnes of carbon dioxide annually (T&E, 2022). Emissions are due to ships departing and entering and emissions from loading, unloading, and refueling activities. The port and the industrial area are managed by the Port Authority of Rotterdam, an unlisted public limited company, held by the Municipality of Rotterdam (approx 70%) and the Dutch government (approx 30%). The authority is fully engaged in maintaining safe and smooth shipping handling and limiting the impact of port activities on the climate and nature. At the operational level, it is directly involved in the development of several green projects: the largest green hydrogen plant; the longest Green and Digital Corridor; Nature 2000 to transform Rotterdam into the Wild Port of Europe, Porthos for the collection and transport of CO2 in the Rotterdam port; moreover

it supports and host relevant green project such as the Neste biorefinery; and it applies various technologies to improve their activities such as the Data Safe House, the acoustic monitoring sensors. The executive board affirms:

> "*We act as an entrepreneurial developer, matchmaker, facilitator, driver, director, investor, and initiator. The Port of Rotterdam Authority acts as the initiator for the development of the expansion of energy infrastructure for hydrogen, heat and CO2 . We establish connections with partners, provide room for business locations and, where necessary, initiate investments. In addition, we are working with partners to expand our position as a production location in the value chain of future-resilient, sustainable activities*".

At the organizational level the port of Rotterdam has a dedicated department to the "Strategic Environment Management" following these projects and maintain contact with key stakeholders which are port clients, employees, local residents, the public and suppliers. The Executive Board affirms:

> "*Engaging in enduring relationships with parties in our environment is widespread practice at the Port of Rotterdam Authority. [...] We talk to our stakeholders about our long-term strategy, policies, goals, and priorities. Engaging in dialogue, with a genuine interest in stakeholder interests and a commitment to achieving a win-win situation [...] We worked with our stakeholders on goals linked to the three focal points of our strategy: Climate and Energy; Safe and Healthy Environment; People and Work*".

At a strategic level, the port has a clear strategy for transforming the port of Rotterdam into a sustainable and green port. The strategy is based on four pillars: efficiency and infrastructure, a new energy system, a new commodity and fuel system, and making logistics chains more sustainable. Efforts in these areas are reflected in three focal points of the strategy: a) accelerating sustainability in the port (e.g., science-based targets initiative; concrete project and partnership); b) smart partner in logistic chains; c) entrepreneurial and effective organization (e.g., multidisciplinary teams). Two of the focal points of the strategy extended the sustainable vision across port boundaries, i.e., the entire port supply chain and the local and regional area: " We are collaborating successfully with many regional and supply chain partners to develop new, circular value chains." Concerning the supply chain, the port of Rotterdam is working to build a green corridor in collaboration with Singapore Port Authority for sustainable and efficient shipping, establishing a broad coalition of shippers, fuel suppliers, and other companies to

develop solutions for the use of low-and zero-carbon fuels. Furthermore, it is leading the digitalization of the supply chain, requiring the adoption of specific tools that monitor emissions and shipping traffic. Portbase is the Maritime Single Window to which ships report their arrival and departure information; Routescanner is the routing function for global container transport.Both suggest transportation choices that are based in part on emissions. Concerning the local and regional area, between lines of the latest annual report is written:

> "*The Port of Rotterdam Authority is a socially committed organisation that wants to make a contribution across the spectrum to the port and industrial complex, and to the liveable city of Rotterdam and its residents*".

The Port of Rotterdam, Rotterdam City Council, Erasmus University Rotterdam, Rotterdam Partners, Rotterdam Festivals, Rotterdam Topsport and Erasmus MC work together for a collective city brand: "Rotterdam Make it Happen", since 2014. The port of Rotterdam is one of the main actors who provides substance to the city brand "with innovation and entrepreneurship; by collaborating and connecting; by moving ahead of the crowd and having the courage to explore new avenues; by thinking about sustainable solutions; by discovery and action". It contribute to three city mission: Smart city; Healthy city and Circular city and it is involved in common project with the city municipality such as "Bluecity", projects on material reuse, the realisation of the biofuel cluster and the implementation of the project "Hydrogen watertaxi". Furthermore, the port plays a key role in increasing the innovation rate of the area. The port hosts one of the major specialized accelerators, "PortXL," and contributes to testing innovation, implementing new technologies, and linking established firms to up-and-coming players.

The Port of Antwerp-Bruges is the second largest port in Europe and the second most polluting in Europe, emitting 7.4 million tonnes of CO2 annually (T&E, 2022). The port is managed by the Antwerp-Bruges Port Authority, a public law limited liability company with the City of Antwerp and the City of Bruges as its shareholders. Even though it is criticized due to the damage it causes to the environment, it develops and implements essential strategies to contribute to the environment, humanity, and the economy. The mission is "*a home port that acts as a lever to create a sustainable futur*e." The Port of Antwerp is working to be the major green energy hub and support a sustainable future. At the operational level, the port is involved in several projects, and all are managed in collaboration

with the area's largest private companies. As the CEO of Port of Antwerp reported:

> *"We are joining forces with seven leading players from the energy and chemical sectors. Together with Air Liquide, BASF, Borealis, ExxonMobil, INEOS, Fluxys, and Total Energies, we are working on innovative CO2 reduction. The project Antwerp@C can potentially reduce the CO2 emissions in Antwerp by half between now and 2030*".

For instance, Antwerp@C is one of the most important projects transforming the port into an innovative energy hub. However, the port is longtime engaged in climate and energy transition. It leverages the residual flows of the Antwerp chemical companies to commercialize energy and supply it to buildings in the city and the port, through the project named "Antwerp-North Heat Network." The project is again led in collaboration with industry, the government, and other social actors. Its sustainable strategy is also supported by incorporating the most environment-friendly technologies available on the market for executing their ordinary tasks, e.g., a tug powered by hydrogen "Hydrotug"; "Hydroville'' shuttle used for sustainable commuter transport within the port area; shore power to mooring ships. At the organizational level, the port has dedicated managers who deal with the sustainable mission: a sustainable transition manager, a program manager hydrogen and a program manager fuel transition. The organization, as planned, is coherent with the port strategy to be "*an active pioneer of the sustainable hydrogen economy, [...] an Europe's leading import hub for green hydrogen*". The port supply chain is managed to spread a sustainable vision and practices. Several smart technologies are used to detect what is happening in the port: a digital twin to control which ships are in which locks and docks, how much energy are our wind turbines producing, smart sensors, and cameras. Jacques Vandermeiren, CEO Port of Antwerp-Bruges, stated:

> "*Port of Antwerp-Bruges is aiming to build a digital nervous system to manage the port remotely fully. By working with innovative partners and opening up the port as an innovation platform, we are making our port smarter, safer, and more efficient.*"

The port is well connected to the city of Antwerp and helps to contribute to the screening, start-up and scale-up of innovative start-ups. The port hosts the port area Next Gen District, an incubator for innovative, sustainable, and circular chemistry. Piet Opstaele, innovation manager at the Port of Antwerp affirmed:

"The Port of Antwerp is an open innovation platform where unprecedented opportunities are offered to test and implement innovative solutions. If it works here, you can roll it out all over the world."

The port offers in fact a space to test new technologies and circular demo projects that have outgrown the lab on a larger scale and in an industrial environment before proceeding to commercialization.

The Port of Hamburg is Europe's second-largest container port and the most important transit seaport (Shakeel, Kirichek, and Chassagne, 2020). Parallel to this, the Port of Hamburg is the third most polluting in Europe, and it is associated with 4.7 million tonnes of CO2 each year(T&E, 2022). The Hamburg Port Authority owns most port properties and deals with the operation and development of the port. Its mission is "*ensure maximum efficiency, safety and economy in all areas of the port infrastructure, looking for innovative approaches to allow us to sustainably exploit the growth potential of the port*". At the operational level, the port is involved in applying intelligent solutions to guarantee a smooth, efficient port operation and protect the environment. Many innovation and digitalization projects are implemented by the Hamburg Port Authority to support green strategies. With the smartPORT philosophy, the Hamburg Port Authority promotes sustainable economic growth and the best possible benefit for customers and people in Hamburg while minimizing environmental impact. The SmartPort Philosophy comprehends that SmartEnergy is composed of actions on renewable energies and shore power from renewable energies. The port exploits quantities of biomass accumulated in and around the harbor area and has a transformer station of energies used to shore power. Differently from the previously analyzed ports, Differently from the previously analyzed ports, the port authority does not have a dedicated department with green responsibilities at the organizational level. The engagement in the improvement of the port supply chain is massive. The port authority explicitly recognizes its responsibility for environmental protection through environmental guidelines involving port clients and providers.

Furthermore, it provides several tools and intelligent solutions (drones, AI, VR, AR) for monitoring the flow of traffic and goods. chainPORT is a global network of logistics hubs that enables maritime players to create secure, efficient, and sustainable supply chains through innovation and digitalization. Hamburg Port Authority's chainPORT initiative creates an international community and aims to bring together port authorities, their partners, and customers to share

experiences and develop joint strategies. The Hamburg Port Authority believes that only the sharing of intelligent data systems and an open exchange will enable sustainable growth. By focusing on innovative technologies, the Authority is adopting a pioneering role in Germany on the issue of a turnaround in energy policy. The link between the port, the city, and the federal government is strong. The city is funding the expansion of the shore power infrastructure for both large seagoing and inland waterway vessels. The port authority affirmed:

> "*The aim is to ensure a sustainably better quality of life in our city and is based on emission reduction.*"

Furthermore, the port contributes to the city's economic development and leverages innovation and start-ups. The port host homePORT aims to give innovative and ambitious port players, science, technology companies, and start-ups the freedom to try, experiment, and collaborate with other partners and actors. For guiding the start-ups, the port collaborates with several actors such as the Authority for Economy and Innovation, Helmut Schmidt University, Technical University of Braunschweig, Hamburg Innovation, 3DStrong, DroneMasters Academy, ALFRED Maritime, Bionic Production, and so on. Start-ups are satisfied by the service offered; the CEO of 3DStrong company stated:

> "*Ports enable the provision and develop important innovation infrastructure acting as innovation centers.*"

Results show ports may act as green port ecosystems, developing and promoting green solutions to address the sustainable challenges. Furthermore, they play the role of innovation hubs that lead the sustainable transition of the local area and their global networks. Comparing the three case studies, we demonstrate the green port strategy reflects on two levels: the supply chain and the local area. The supply chain level means ensuring the port diffuses sustainable practices through a monitoring system of client activities. Adopting and promoting sustainable and digital value chain solutions focuses on customer value and supports clients to reach sustainable goals, guiding and digitizing their operational actions. As de Langen and Sornn-Friese and Hallworth (2020) describe, the port represents a business ecosystem at this level. Maintaining a sustainable strategy at the local level and generating a sustainable effect on a large scale transforms its role in the innovation hub. It increases its commitment to innovation projects such as big projects on the energy transition or small projects financing and hosting innovation start-ups. At this level, the port brings together the local development strategy with that of the port and those of key

private companies located in the area (Witte et al., 2018). The port leverages its existing network of actors and their respective knowledge and competencies to re-design the network for developing sustainable innovations and attract young talents and innovators to accelerate the sustainable transition. In this sense, the concept of the green port is much closer to that of an innovation ecosystem since it focuses on developing green solutions and guides the green strategy within and for the entire local area.

5 Conclusion

This paper examines green ports by adopting the lens of the innovation ecosystem and discusses best practices that may be extended to other traditional industries that are forced to be engaged in sustainability, illustrating how they can do it and which benefits gain in adopting the innovation ecosystem approaches. Although definitions of green ports are frequently included in previous studies, most are often described superficially without providing much detail. In this study, we tried to explain how the green port concept evolved from past to present beyond the general definitions in the literature. The theoretical contribution of the study is not only for the development of this concept but also to reveal what sustainable green port strategies are, both in theory and in practice, with three selected case studies. From a theoretical point of view, the study presented a unique conceptual framework by interpreting the ports in light of the innovation ecosystem under the concept of the green port. Despite its valuable contribution, this study presents some inherent limitations that should be addressed in further research. First, the case study is limited to three cases. Therefore, the scope should be expanded with more case study examples. Second, only the case study was chosen as the research method; therefore, substantial secondary data were used. In future studies, using the interview method and case studies can improve research the addition of quantitative methods can strengthen studies.

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Project Manager Competencies and Learning: A Literature Review

Teresa Anna Rita Gentile*

Dipartimento di Scienze Aziendali
Università degli Studi di Salerno
Via Giovanni Paolo II n. 132, 84084 Fisciano (Salerno), Italy

Paola Adinolfi

Dipartimento di Scienze Aziendali
Università degli Studi di Salerno
Via Giovanni Paolo II n. 132, 84084 Fisciano (Salerno), Italy

Ernesto De Nito

Dipartimento di Scienze Economiche e Statistiche
Università degli Studi di Salerno
Via Giovanni Paolo II n. 132, 84084 Fisciano (Salerno), Italy

Michelangelo Misuraca

Dipartimento di Scienze Aziendali e Giuridiche
Università della Calabria
Via Pietro Bucci, Cubo 1C
87036 Arcavacata di Rende (Cosenza), Italy

Luigi Maria Sicca

Dipartimento di Economia, Management, Istituzioni
Università degli Studi di Napoli Federico II
Complesso di Monte S. Angelo, Via Cupa Cintia, 21,
80126 Napoli, Italy

** Corresponding author*

Abstract

The project manager must possess various skills in order to achieve the goals set in the project for which he is responsible. According to the existing literature, these managerial skills possessed by the project manager can be not only of the hard type (technical), but also of the soft type (behavioural or transversal). In order to better understand these dynamics, the aim of this research is to present the discussion about how project managers learn soft skills according to the scientific literature. The purpose, specifically, is to map and group the various articles published, from 2003 to 2022, to have an overall representation of the studies carried out.
The methodological approach used was quantitative through a literature review that took place in three phases. The main results showed that the most prominent research areas are knowledge management, the typologies of skills and the learning method and style.

Keywords – Management education, experiential learning, literature review

Paper type – Academic Research Paper

1 Introduction

The way of working in organizational contexts, both public and private, is becoming more and more based on the "project" which requires the figure of the project manager within it (Cheng, al., 2005; Magano, et al., 2020). Specifically, the project manager (PM) is the person in charge of leading the group he is responsible for in achieving the project objectives (PMI, 2017) who must possess different skills (Jena and Satpathy, 2017; Liikamaa, 2015).

Thus, if on the one hand according to Boyatzis (1982) competence constitutes "*an intrinsic characteristic of an individual that leads to effective performance*", on the other according to Jałocha, et al. (2014), the project manager should possess specific managerial skills and generic skills. But while the specific skills would be those of a technical type (hard skills) essential for project management and those for working towards the achievement of the project objectives (Jałocha, et al., 2014; Ribeiro et al., 2021).

The so-called soft skills would be those concerning the behavioral or transversal aspect and which would be common to all managers, regardless of the sector in which they work (Grugulis, and Vincent, 2009; Jałocha, et al., 2014).

Thus project managers should possess behavioral skills attributable to leadership skills regarding the ability to lead, motivate and direct a team, studying

people: their behaviors and motivations (Jena and Satpathy, 2017; Moradi, et al., 2020; PMI, 2017), helping to have self-awareness and teamwork. The idea would be to work together like a basketball team, where each team member is given a specific role to play in order to successfully complete the job (Jena and Satpathy, 2017).

But the issue of soft skills that project managers should possess opens the debate on learning, i.e. on how project managers should acquire these soft skills, perhaps by following appropriate training courses that allow for a change in skills, knowledge, attitudes or behaviors (Magano, et al., 2020; Treven, 2003): focusing, for example, on improving job performance in the areas of human relations, self-awareness, problem solving and decision-making, motivation/values and general management (Burke and Day, 1986). Furthermore, questions are asked about their real value in certain working contexts and about how, specifically, the project manager's personality traits and dimensions (soft skills) can allow the projects to be carried out effectively and successfully (Creasy, and Anantatmula, 2013).

In the field of project management this theme is significant and therefore the objective of the research is to verify how the literature examines and discusses the learning of soft skills by the project manager. The purpose, specifically, is to map and group the various articles published on the relationship between learning and soft skills of project managers, in the last twenty years (from 2003 to 2022), in order to have an overall representation of the current trend of the studies carried out.

The article has been organized as follows. The adopted methodology will be presented in the next section. Subsequently, the paragraph on the main results achieved will be shown. Finally, in one section we will present the discussions and conclusions.

2 Methodology

The methodological approach adopted was quantitative. The work took place in two different phases.

(1) The articles were found through the inclusion of some keywords in the Web of Science (WoS) and Scopus platforms covering a period ranging from 2003 to 2022. We queried on March 2023 the two main indexing databases (WoS and Scopus) to retrieve the main references of the literature concerning learning and project management. We employed in particular a search string including the

term "project manag*" AND "learning" AND ("soft skill*" OR "competenc*"). In recent years there was an intense debate concerning which database is better (e.g., de Winter et al., 2014; Harzing and Alakangas, 2016; Pranckutė, 2021). Each database has strengths and weakness, and the choice should be guided by the different research goals and the reference sphere (Falagas et al., 2008). WoS covers a wide range of disciplines, including science, social sciences and humanities. It is known for its strong coverage of high-impact, peer-reviewed academic journals and conference proceedings, but has limited coverage of non-English language publications. Scopus, on the other hand, covers a wider range of sources than WoS and includes more open access publications and more publications written in languages other than English. Since it is impossible to generate a completely exhaustive query, there are always false positive and false negative results. Scopus, for example, considers a wider time-span than WoS but with a higher rate of duplicated citation records, mainly caused by a certain lack of standardisation (Valderrama-Zuriàn et al., 2015; van Eck and Waltman, 2017). The joint use of the two sources allowed leveraging the different features they hold, widening the coverage of the surveyed research domain.

(2) The selection of articles was done through Preferred Reporting Items for Systematic Reviews and Meta-Analyzes (PRISMA) by Moher et al. (2009). Figure 1 depicts schematically the different steps used in the construction of the dataset. The analyses were focused on the last 20-year literature produced in English and published on journals, books, and conference proceedings. After cleaning and filtering the two datasets obtained by WoS and Scopus separately, we merged them in one dataset and removed duplications. The result is a set of 864 bibliographic records used both for *performance analysis* and *thematic analysis*.

Performance analysis (e.g., Peters and van Raan, 1991; White and McCain, 1998) aim at evaluating through bibliographic data the productivity and the impact of different actors involved in a research domain (authors, institutions, countries).

Thematic analysis, as an approach to science mapping (Börner et al., 2003), tries instead to depict the cognitive patterns of the analysed domain, visualising the major topics in a synchronic (Callon et al. 1983) or a diachronic perspective (Cobo et al., 2011). Thus, we were able to explore the conceptual structure of the publications through thematic analysis. The textual content of publications' abstracts has been algebraically represented by using the Vector Space Model (Salton et al., 1975). After pre-processing the collection to filter not informative terms, a abstracts x terms binary matrix X with n rows and p columns is built. Each

generic element xij (i = 1, …, n; j = 1, …, p) assumes 1 or 0 depending if a term j appeared or not in a publication's abstract i. From X, it is then possible to derive a p-dimensional terms x terms matrix C, whose generic element cjj′ (j ≠ j′) represents the number of abstracts in which terms j and j′ co-occur (i.e., they are both present in an abstract). This matrix can be graphically depicted as a network, where each node represents a term, whereas each link between two terms expresses their connection (for a more detailed description see Misuraca and Spano, 2020).

Performing on this network a community detection – a method similar to clustering that group nodes in highly cohesive sub-networks – allows identifying groups of terms representing different themes/topics embodied in the collection. In particular, the walktrap algorithm proposed by Pons and Latapy (2005) showed high effectiveness in comparison with other competing proposals. The topics obtained through the community detection can be visualized in a thematic diagram, according to centrality and density measures for each topic. The measures express the participation of a topic in the organization of the domain's conceptual structure, with the centrality expressing the importance of the topic in the entire research domain and the density expressing the theme's development.

The thematic diagram can be interpreted looking at the four quadrants present in the map:

- *motor topics (I*) have higher values of centrality and density, representing the issued necessary for structuring the research domain;
- *basic topics (II)* have higher values of centrality but lower values of density, representing the issues essential for the domain and transversal to its different research areas;
- *emerging or declining topics (III)* have lower values of centrality and density, representing weakly developed or marginal issues in the domain;
- *niche topics (IV)* have lower centrality values but higher values of density, representing strongly developed but marginal issues in the domain.

All the analyses reported have been carried out by using the library *bibliometrix* (Aria and Cuccurullo, 2017) in the R environment.

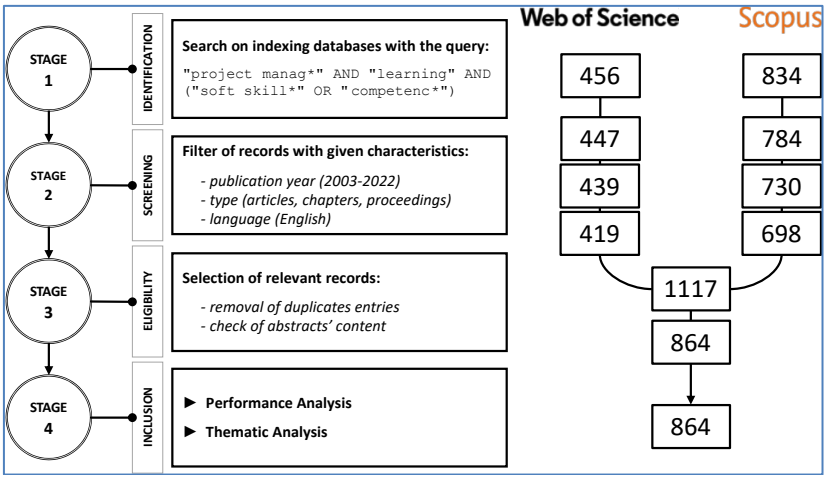

Figure 1: PRISMA flowchart with the data searching and selection steps

3 First results

The first results on the *performance analysis* and the *thematic analysis* revealed the following situation.

Performance analysis. Regarding *performance analysis* in terms of bibliographic contributions on learning and project management based on the number of authors, their nationality and the institutions involved, some significant graphs are shown below.

In particular, the scientific production of publications concerning learning and project management increased across time (Figure 2), with a growth rate of 4.84% per year. Each publication included in the collection received, on average 7.14 citation. We observed a quite low share of single-authored publications (16.97%), a very low share of publications produced by international co-authors (6.25%), revealing in this domain a strong cooperation among scholars but at a national level.

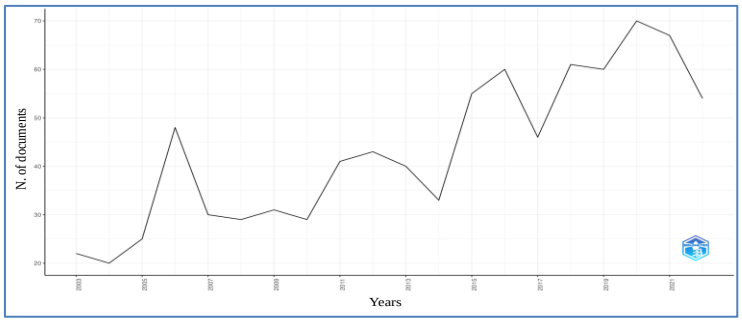

Figure 2: year-wise distribution (2003-2022) of publications included in the collection

As concern the scientific production per country, in the absence of a clear indication of the geographical localisation of publications in the indexing databases, we considered as a proxy the corresponding author's country. In Figure 3, it is possible to see how U.S. produced the greater share of publication in the field across years. Nevertheless, it is interesting to note how Spain increased the scientific production after 2013, with a growth rate greater than other leading countries like United Kingdom, Germany, and Australia.

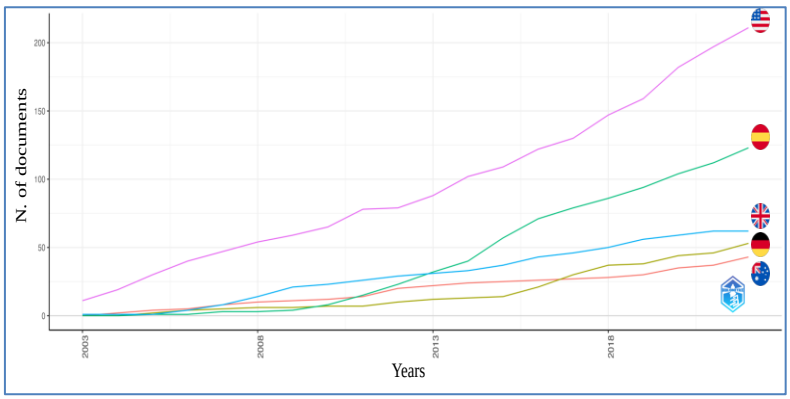

Figure 3: year-wise distribution (2003-2022) of publications for the top-5 countries

Observing more in-depth the social structure of the research domain, we can highlight which were the top-5 leading institutions in the last 20 years. As previously stated, we had to consider the corresponding authors' affiliations as a proxy of the institutions. In accordance with the findings reported above, we found in the first positions four U.S. universities and one Spanish university (as depicted in Figure 4). Interestingly, both DeVry University and Illinois Tech (3rd and 4th position, respectively) are located in the U.S. State of Illinois.

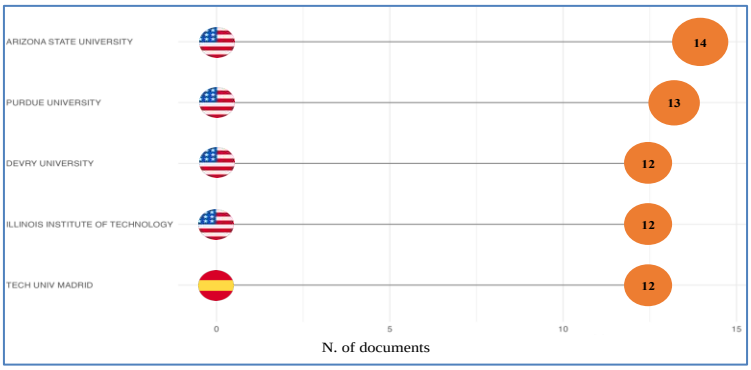

Figure 4: top-5 leading institutions in the analysed collection (2003-2022)

At an individual level, surprisingly, the most productive authors were not located in the top-5 leading countries neither in the top-5 leading institution. As showed in Figure 5, we found two authors from Romania (C.N. Bodea and M.-I. Descalu (2010), from the Bucharest University of Economic Studies and the Polytechnic University of Bucharest, respectively), two authors from Portugal (R.M. Lima and D. Mesquita (2020), both from the University of Minho), and one author from Norway (B. Hussein (2021) from the Norwegian University of Science and Technology). The presence of authors from the same country and/or institution confirm, as claimed above, the strong cooperation among authors at a national level. This aspect can be also highlighted looking at the collaboration networks of the authors (Figure 6), in which some research groups more frequently occurrent can be noted.

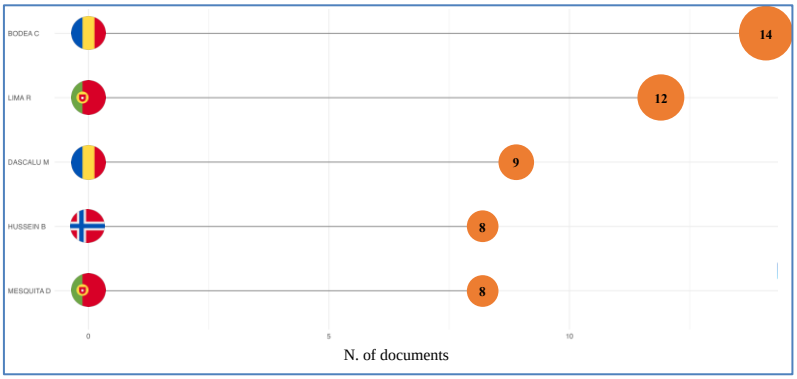

Figure 5: top-5 leading authors in the analysed collection (2003-2022)

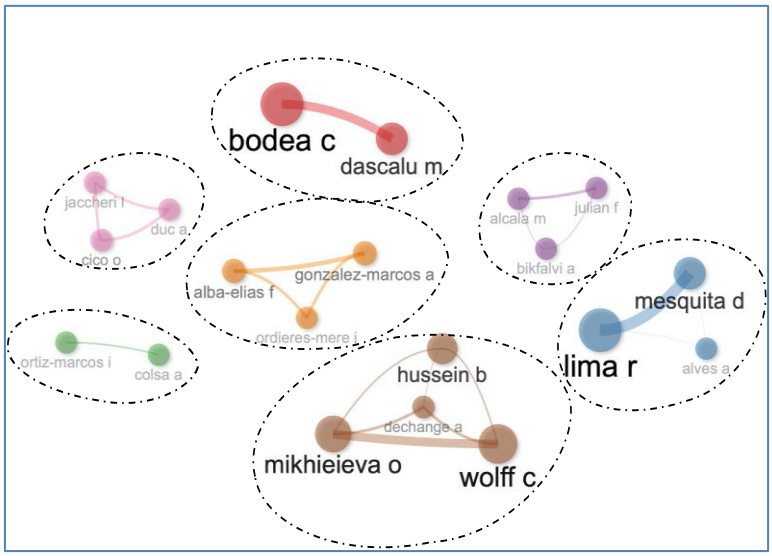

Figure 6: authors' collaboration in the analysed collection (2003-2022)

The impact of the scientific production in the field of learning and project management may be evaluated by considering the most important sources (also considering the *h*-index and the other metrics used in the indexing databases to quantify the relevance of a journal or of a conference) and the most important publications in terms of total number of citations. In Figure 7, the top-10 sources appearing in the analysed collection are graphically represented.

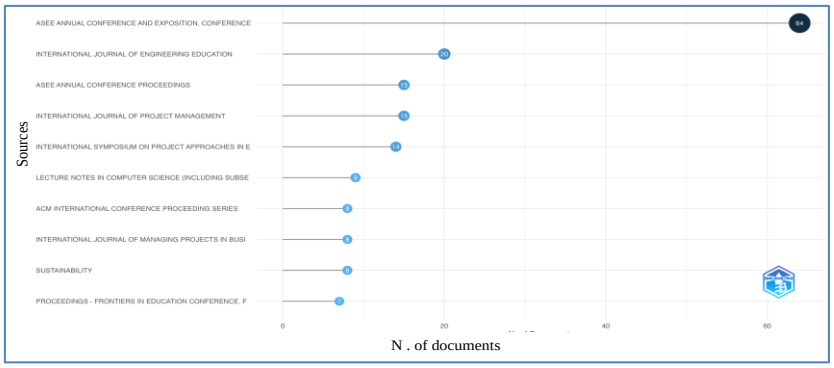

Figure 7: top-10 sources in the analysed collection (2003-2022)

As concern the most relevant publications included in the collection, it is possible to consider the total number of citations (Figure 8) as a measure of the impact of each contribution in the surveyed literature.

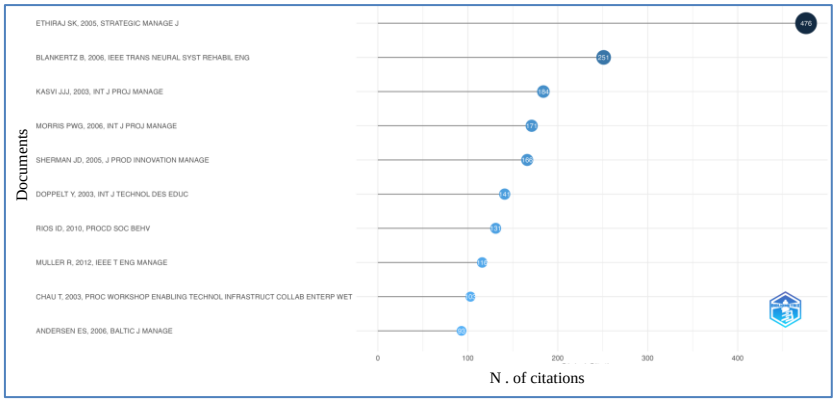

Figure 8: top-10 most relevant references in the analysed collection (2003-2022)

Thematic analysis. Figure 9 graphically represents the topics debated in the learning and project management literature under investigation, highlighting the different kind of issues.

The following paragraph highlights some observations regarding the main topics raised.

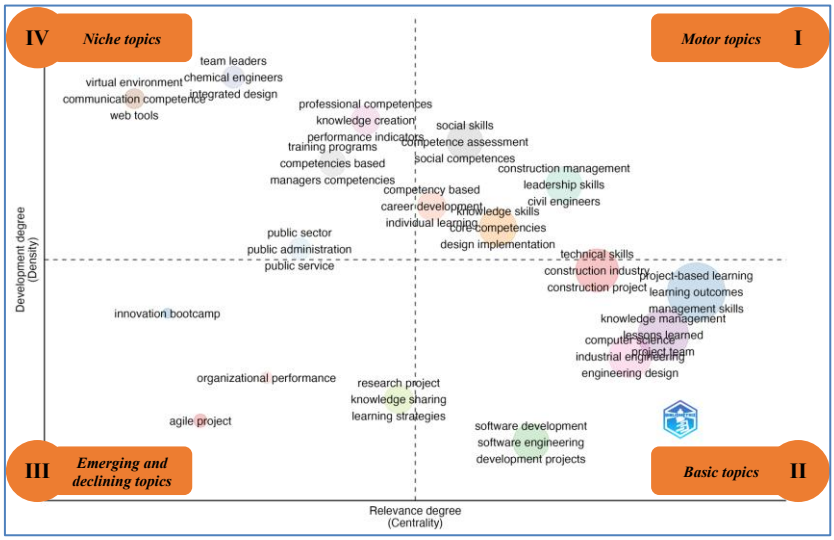

Figure 9: thematic diagram of the topics debated in the analysed collection (2003-2022)

4 Discussion and conclusions

Analysing the relationship between soft skills project manager and the learning process is quite useful to discuss how literature was focused on this important issues and to understand which are the main issues that emerge around this topic.

Specifically, three main research areas emerge from the literature review: 1) knowledge management; 2) the typologies of skills; 3) the learning method and style.

Concerning the first research area, surprisingly in many articles is possible to find studies or implications related to the knowledge management field. Beyond the label "knowledge management" there are other expressions such as knowledge creation, knowledge sharing, lesson learned that could be easily associated with the complex KM area. What is particularly interested from our point of view is the idea that acquiring soft skills is part of more complex and broader strategy that affects the entire organization. Referring to knowledge management, in fact, implies reasoning about all the strategic choices organizations make, in order to facilitate the different goals to guarantee a better and structured way to use knowledge inside the organization. If this is true, then, the learning process of soft skills project managers, become a complex process that involves the most important part of the organizations.

The typologies of skills are another central category that emerges from the data analysis, in different ways and forms. First of all, there are some general categories such as managerial competence, or social skills that refer to all the behavioural competences that are more and more important for project managers. Then it is possible to individuate some specific competences that could be considered particularly relevant. For example, team management competencies (such as leadership) or communication skills. While the first group is team specific, the second one reminds us that the role of project manager is not just about managing people in a team, but also dialoguing with other external stakeholders. And maybe this implies a more responsible role for project manager, that following a more strict project management language, becomes project sponsor or project coordinator. In this sense it would be very interesting discussing about a possible role's evolution maybe due also to the spread of project management or projectification in general. The last research area is related to the learning style and method and data show how the issue of learning

is considered at a general level, finding expressions such as learning strategies and learning outcomes. Surprisingly there is not any reference to the concept of experiential learning that could be considered as one of the prominent methods to reflect on behavioural competences. The only concept that could be associated to the behavioural dimension is the competence assessment. This is clearly an important issue that involves the role of assessment both in the selection and in the education process. It would be interesting to discuss how the assessment is investigated and if there are some examples of outdoor training or other original forms to work on soft skills. This is really a key point because many consultants are suggesting to adopt this kind of learning program to give project managers the possibility to experiment different soft skills in situations outside of the job contest.

Our paper is a first attempt to open up a debate on the relationship between learning and soft skills for the project manager, identifying the research areas to develop in order to contribute to a critical managerial debate.

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Exploring the Intersection of Technology, Digitization, and Innovation in Sustainable Knowledge Management: A Bibliometric Network Analysis

Carlo Drago[1]*

Università degli Studi Niccolò Cusano – Telematica Roma
Via Don Carlo Gnocchi 3, 00166, Roma

Fabio Fortuna

Università degli Studi Niccolò Cusano – Telematica Roma
Via Don Carlo Gnocchi 3, 00166, Roma

* *Corresponding author*

Abstract

This article investigates the link between technology, digitalization, and knowledge management using digitalization and knowledge management to achieve sustainable development. In addition to the increased interest in knowledge management for implementing sustainability, technology, digitization, and knowledge management have an important influence on promoting sustainable economic systems. Knowledge resources must be exploited and managed, and a knowledge management system must be created to solve sustainability issues. Digital technologies such as Big Data are particularly significant in the context of sustainability since they provide improved decision-making processes. Furthermore, using digital platforms facilitates inter-organizational communication and information exchange by facilitating the exchange of best practices and collaboration. Using bibliometric network data analysis methodologies, we propose exploring the links between technical development, digitalization, and innovation in knowledge management for sustainable growth. The "core" themes covered in the literature will be determined using bibliometric analysis based on network-based methodologies, specifically community-detection algorithms. This information will be optimized using ensemble methods, and any possible bias from the many algorithms will be eliminated.

The relevant results of this work emphasize the role of new technology, innovation, and digitalization, all playing a vital role in the applicability of these findings to sustainability. Organizational reforms and internal strategic approaches are required to apply these technologies effectively and sustainably. This study adds to the expanding body of research on sustainability, knowledge management, and digitalization by shedding light on

[1] *We thank two anonymous referee for their comments and suggestions.*

the interrelationships between these factors and emphasizing the significance of adequately managing knowledge resources to address sustainability concerns. Five essential organizational performance and sustainable growth principles have emerged: knowledge management, sustainability, innovation, intellectual capital, and corporate social responsibility.
Additionally, the analysis emphasized the significance of leadership in knowledge management processes. Several clusters also highlighted the significance of promoting sustainable growth through collaboration, innovation, and knowledge transfer. Small and medium-sized firms (SMEs) may benefit from intellectual capital and open innovation initiatives to better their knowledge management procedures and support sustainable growth. Growth and competitive advantage can be attained if these concepts are managed effectively. A firm's success depends on its leadership and ability to share and transfer information. Therefore, the sustainable growth of a business needs a knowledge management process that is backed by a strategic approach and incorporates knowledge exchange and transfer in its design.

Keywords – Knowledge Management, Technology, Sustainability, Innovation, Bibliometric Analysis

Paper type – Academic Research Paper

1 Introduction

While sustainability has become increasingly complex over the last few years, there is a growing interest in knowledge management to implement sustainability (Martins et al., 2022). Technology, digitalization, and knowledge management significantly promote sustainable economic systems (Castagna et al., 2020; Fortuna et al., 2023; Fortuna et al., 2022). Furthermore, to meet sustainability challenges, organizations may benefit from utilizing and managing their knowledge resources more effectively to find solutions to those challenges properly (Awan et al. 2020, Vartanova et al. 2021). Therefore, implementing a knowledge management system is crucial (Ray 2008). In order to do that, collecting, storing, and analyzing vast amounts of relevant data is essential, for example, in promoting sustainable process innovations (Nwankpa et al. 2021). So, the advent of Big Data and other digital technologies can be considered powerfully relevant to knowledge management processes. After all, they allow an improvement in decision-making in a context of sustainability because they also promote the rise of new analytic approaches critical to the discovery of relevant data patterns (Schmelzer, 2023, Kibria et al., 2018, Allam & Dhunny, 2019, see also Siddiqa et al. 2017 for a survey of big data storage technologies).

In addition, the new digital platforms also facilitate communication and information sharing between different organizations (Möhlman & Jarvenpaa 2019), which can also positively impact sustainability by enabling the sharing of best practices and collaboration (e.g., to implement processes and products better). It is also possible to better monitor sustainability practices and promote accountability and transparency in processes. Sustainability is in some ways more strongly impacted by knowledge management technologies (Hossain et al. 2022).

The purpose of this article is to explore at an exploratory level the relationship between technology, digitalization, and innovation in knowledge management for sustainability (see also Sanchez Ramirez et al. 2022). This is done by using bibliometric data analysis techniques of the relevant literature in order to examine the different relationships between these elements (see Donthu et al. 2021, Drago et al. 2021). There is increasing use of bibliometric analysis techniques to review the existing literature and identify key topics and relevant results published in the literature (see, for instance, Naciti et al. 2022). In addition, bibliometric analysis is increasingly applied to examine any significant gap found within the literature to identify the most relevant topics and results.

More specifically, we will consider network-based approaches to bibliometric analysis (see, for instance, Abdullah & Mahmood 2020) to identify most specifically the "cores" of the literature in terms of topics by using relevant techniques and algorithms community-detection-based (Fortunato 2010). The communities are groups of co-occurring keywords on the articles, strongly connected. In this way, there is a clear indication of relevant "core" concepts discussed in some papers which are part of the literature. The keyword members of these communities, however, are not strongly connected to each other different member of other communities (Fortunato, 2010; Drago et al. 2021). Community detection algorithms aim to extract these basic data patterns from the literature. Nevertheless, the results can depend on the algorithm considered, which can be biased by existing data structures (Leskovec et al. 2010). The advantage of using an ensemble methodology (see Dahlin & Svenson 2013, Drago 2018; Drago & Balzanella 2015) is the possibility to optimize the information, which is possible to obtain from these techniques in terms of relevant, robust groups to eventual occurring biases of themes and relationships that emerge from the different topics.

The practical relevance of these results is high due to the importance of new technologies, innovation, and, at the same time, digitalization in knowledge

management, and it should not be underestimated. In addition, these results demonstrate how knowledge management contributes to sustainability (Ochoa-Jiménez et al. 2021, Martins et al. 2022, Hossain et al. 2022, Weina & Yanling 2022, Tajpour et al. 2022).

However, these technologies require adequate organizational changes and internal strategic approaches, so it is necessary to simultaneously develop adequate changes in organizational issues in the company and new business models (Parida et al., 2019, Ruggieri et al., 2022). These changes may or may not lead to a successful implementation of these technologies in a sustainable manner. The article's organization is as follows: in the second section, we will present and discuss the dataset used. In the third section, we will present the results in the first paragraph. Then we discuss the practical implications. Finally, in the fourth section, there are the conclusions.

2 Data and Methodology

Quantifying the amount and quality of academic publications using bibliometric analyses of bibliographic data is possible (Donthu et al. 2021, Drago & Aliberti 2019, Gatto et al. 2022). Using these analytics, authors, institutions, and publications may better comprehend their place among reference research disciplines (Li et al., 2021). Furthermore, bibliometric data may be used to identify the key trends in a particular area of study or assess the influence of a particular author on the academic community (Kiyomi et al., 2022). In this respect for academics, publishers, research funders, and government organizations, bibliometric studies are beneficial for objectively assessing the quality and effect of research. Also, it is crucial to conduct bibliometric studies in economics since they may reveal whether economic variables (for instance, economic activity and innovation) can have an impact on other relevant variables and so the existence of robust economic relationships in a good or negative way (Kumar et al. 2022). Bibliometric analysis may be considered to assess research publications in scientific and technology domains, such as start-ups and successful corporations (see, for instance (Damayanti et. 2023). Information like this may also assess whether policies supporting innovation and research produce the expected results, such as rising productivity and competitiveness (Akbari et al., 2020). Moreover, bibliometric evaluations may pinpoint high-priority research topics and chances for corporate and academic institutions to collaborate, allowing the

knowledge economy to reach its full potential. So the research question explores the relationships between technology, digitization, and innovation in sustainable knowledge management.

The data used comes from the following query:

TITLE-ABS-KEY (technology OR digitization OR innovation AND "Sustainable Knowledge Management" OR "Sustainability" AND "Knowledge Management")

The query was performed the 14\3\2023 using Scopus obtaining 787 publications which are the bibliometric database considered in the analysis. In the context of bibliometric analysis of publications, Scopus is often used to retrieve data for bibliometric analyses of journals and books to perform those analyses (Al-Khoury et al., 2022). Scopus, one of the most popular databases owing to its broad coverage of academic publications, provides scholars with access to a comprehensive database of scholarly publications. This makes Scopus the database of choice for researchers (Ismail et al., 2022). The methodology considered in this work focuses on network analysis based on the co-occurrences of the specific keywords identified (see Drago et al. 2021). In this respect, the analysis is based on a community detection approach in which we can identify some relevant communities of keywords that are maximally connected in the considered literature covered by the bibliometric dataset.

Furthermore, the ensemble approach using multiple correspondence analysis proposed by Drago (2018) allows for robustifying the different results considering different relevant approaches and algorithms. Finally, a comparison with a methodology based on multiple correspondence analysis to visualize the different keywords in a conceptual structure map is proposed to analyze the sensitivity of the results considering different methods. The approach based on multiple correspondence analysis (Greenacre & Blasius eds. 2006) is also based on a hierarchical clustering helpful approach to identify the most relevant groups of concepts which can be extracted from the literature (Aggarwal & Reddy 2016).

R is the programming language used to perform the analysis where the packages used are *bibliometrix* (Aria & Cuccurullo 2017), *igraph* (Csardi & Nepusz 2006) and *clValid* (Brock et al. 2008).

3 Results

3.1 The Network-based ensemble community detection analysis

Based on the bibliometric analysis, the results: can be described as follows: first of all, we have computed the network of the key co-occurrences (figure 1). Then, we can observe the relevance of five relevant concepts from the network of crucial co-occurrences. The first relevant group of linked concepts is based on the core relationships between knowledge management, sustainability, innovation, and intellectual capital (Salehi et al., 2022).

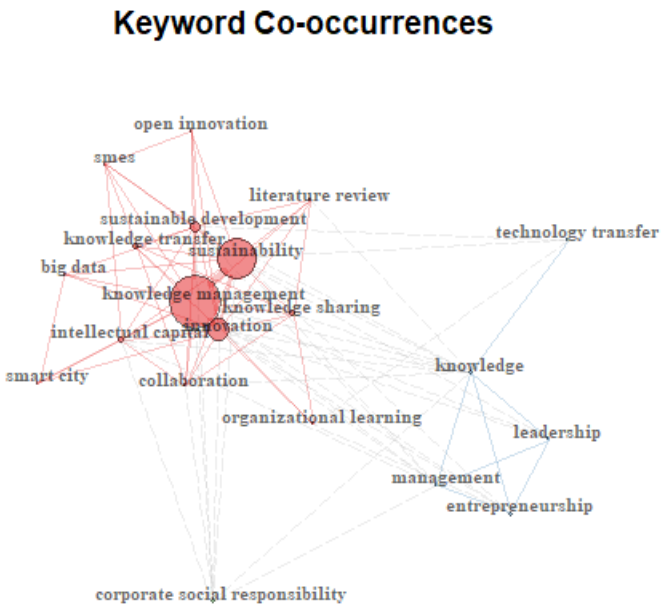

Figure 1. Network visualization of the keyword Co-occurrences

A second important concept is related to corporate social responsibility, where a third is related to technology transfer, and finally, a fourth to organizational one: knowledge management, leadership, and entrepreneurship (see in this sense, for instance, Suri Babu et al. 2008, Politis 2001). These different relevant concepts (or network communities) extracted are assessed considering a more specific community detection analysis based on the ensemble of different methodologies, and the results are visualized in figure 2. First, the different economic concepts

are expressed more clearly after a formal cluster analysis considering the coordinates of a multiple correspondence analysis. In this respect, we identified 4 clusters based on a group of relevant keywords and 6 clusters on single (important) keywords considered singularly. Next, we clarify the original network's relevant concepts, observing that a first cluster based on group keywords shows important relationships in the literature on knowledge management, innovation, sustainability, and collaboration (see Johannessen et al.; An et al. 2014). Then the second cluster can be observed based on knowledge transfer and sharing. In this sense, we can identify knowledge management's relevance in sustainability, collaboration, and innovation based on knowledge transfer and sharing (see also Widyasari & Nasution 2022).

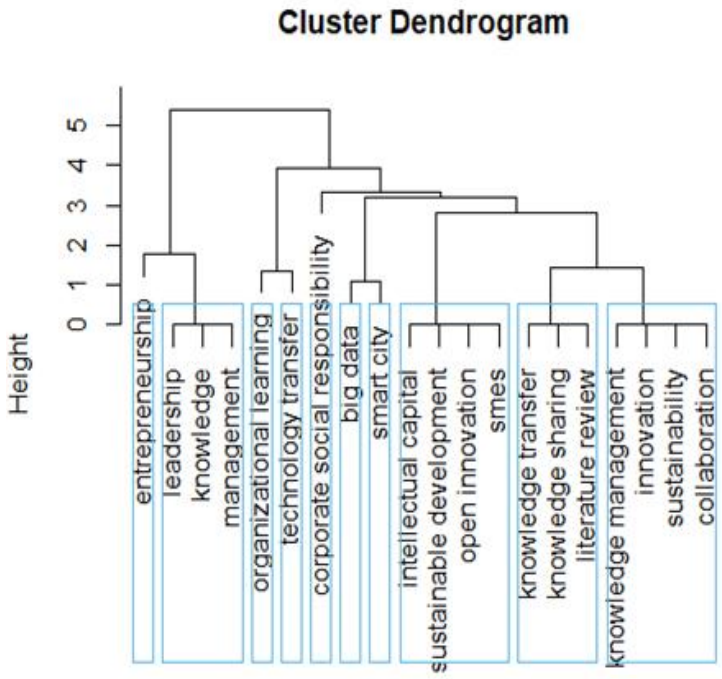

Figure 2. Dendrogram of the ensemble community detection approach

Then small and medium-sized businesses (SMEs) cannot overstate the significance of intellectual capital and open innovation. These two concepts boost the knowledge management processes of small and medium-sized enterprises and encourage sustainable development. Moreover, by efficiently managing intellectual capital and embracing open innovation strategies, SMEs can generate

new opportunities for development and competitive advantage (Millers & Gaile-Sarkane 2021).

In addition, the analysis of the overall network and specific clusters reveals the significance of leadership in knowledge management. By providing the necessary guidance and support, leadership can facilitate knowledge sharing, transfer, and innovation among employees and enhance organizational performance (for instance, Muhammed & Zaim, 2020, Arunga & Kilika 2023). Furthermore, the leadership of SMEs fosters sustainable development and improves knowledge management procedures, which are crucial SME elements.

Intellectual capital, open innovation, and leadership are assets that leaders of SMEs cannot undervalue. In addition, knowledge management processes can enhance organizational effectiveness and promote sustainable development. In this respect, leadership can be relevant in innovative processes which can be considered toward a firm's sustainable growth.

Finally, in figure 3, we can compare the results obtained by observing the multiple correspondence analysis. The results obtained from the ensemble community detection of the literature network are substantially confirmed. The axis can be interpreted as follows: on the left, we have the managerial and strategic issues related to knowledge management in action for innovation and sustainability, whereas, at the bottom, we have the technological impact on the environmental issues (in the middle, we have as a relevant topics environmental management). This axis confirms our previous analysis showing the importance of leadership and management strategy. Implementing solutions to environmental, social, and economic challenges through effective leadership and strategic management drives innovation and sustainable business practices (see also Mrusek et al. 2022).

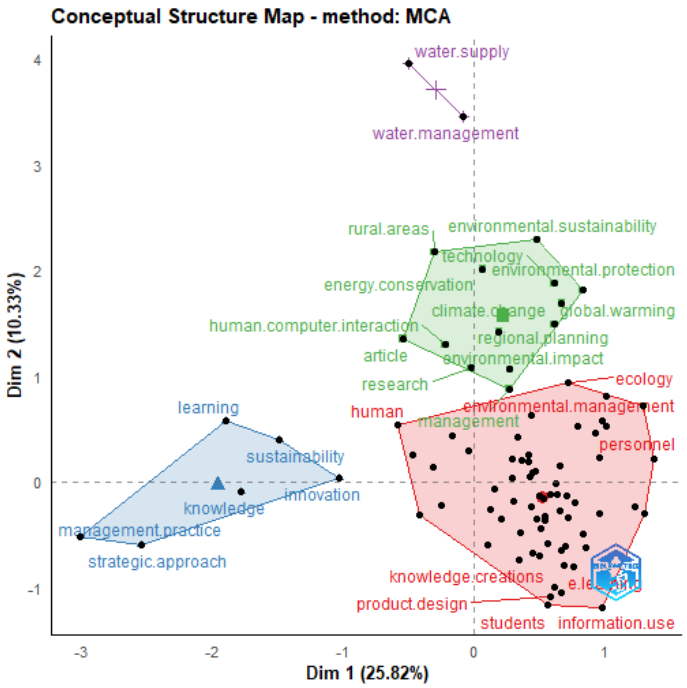

Figure 3. Conceptual Structure Map: method multiple correspondence analysis.

At the same time, we can identify two large clusters indicating relevant topics in the literature. A first cluster related to knowledge management and its importance on the firm's sustainable growth (including relevant topics such as knowledge transfer and knowledge sharing) can be identified. So, in the first axis on the opposite side (on the left), we also see another relevant cluster based on the firm's managerial practice and style but also on the different strategic issues that can be relevant. Finally, a third relevant cluster is related to essential concepts such as environmental impact, sustainability, and energy conservation, so it is related to the literature concepts that consider technology in the context of sustainability. This concept allows one to understand better that relevant concepts in a firm toward long-term sustainability are good knowledge management processes that need to be empowered while considering knowledge sharing and knowledge transfer.

In these contexts, processes of change leading to innovative new technologies (digitization, big data, for instance) should be sustained by considering good management practices and strategic approaches toward a higher capacity for the business to grow in an environmentally sustainable context also externally

communicating their outcomes (in this respect see Testarmata 2018). So in this way, leadership and corporate social responsibility (see Fortuna et al. 2020) are significant. Finally, stakeholder approaches to business are supported by leadership, strategic management, innovation, and sustainable business practices (see Suriyankietkaew & Avery 2014). Therefore, in order to achieve long-term success and create shared value for all stakeholders, it is essential to consider stakeholder interests when developing and implementing sustainable business practices (Freeman et al., 2010).

3.2 Implications for Business Practice

The link between knowledge management, corporate social responsibility, sustainability, leadership, and knowledge transfer has a variety of practical ramifications. Given this setting, we may make the following practical conclusions:

A knowledge management approach that encourages information sharing, supports learning and enables innovation may enhance corporate social responsibility and sustainability. Organizations should encourage staff to share their best practices and lessons gained on sustainability efforts to foster continual progress.

Organizations may inspire and encourage staff to participate in sustainable activities to improve sustainability and corporate social responsibility. Leaders may set a good example by leading and discussing sustainability with their staff.

Knowledge transfer may improve an organization's capacity to manage knowledge successfully and build sustainable processes. For instance, firms might build communities of practice that allow the exchange of information and cooperation amongst personnel working on sustainability projects. In addition, by establishing a pool of knowledge and expertise that can be used for sustainable business operations, it is possible to increase a company's intellectual capital.

Using sustainable practices promotes sustainable growth for organizations. In addition, organizations may minimize their carbon footprint via energy-efficient technology, diversity, and inclusion in the workforce.

Sustainability may be incorporated into an organization's overall strategy to guarantee that sustainability and corporate social responsibility are wholly integrated into its operations. For example, the United Nation’s Sustainable Development Goals can be matched with business practices, and sustainability indicators might be devised to track progress toward sustainability objectives.

In conclusion, technology, innovation, corporate social responsibility, and knowledge management are interconnected in several practical ways. In addition to improving competitiveness, fulfilling social duties, and fostering sustainable development, companies may gain from implementing these principles and strategies.

4 Conclusions

This study concludes by emphasizing the significance of technology, digitalization, and knowledge management in promoting sustainable economic systems. Organizations may solve sustainability concerns and foster sustainable process innovation by exploiting and managing knowledge resources more efficiently.

Big Data and other digital technologies are very relevant to knowledge management procedures from a sustainability perspective. With the exchange of best practices and cooperation, digital platforms allow inter-organizational communication and information sharing, positively affecting sustainability.

Bibliometric network data analysis methodologies have been used to explore and understand the link between technology, digitization, and innovation in knowledge management for sustainable development. By identifying the "core" ideas covered in the literature, our results shed light on the significance of effectively managing knowledge resources to arrive at sustainable solutions.

Overall, this study contributes to the expanding body of research on sustainability, knowledge management, and digitalization by shedding light on the interrelationships between these factors and highlighting the necessity to manage knowledge resources to promote sustainability effectively. Notably, successfully applying these technologies necessitates organizational adjustments and internal strategic approaches. Therefore, future studies should concentrate on establishing sustainable knowledge management and practical technology implementation solutions.

Network-based bibliometric analysis in this research examined the link between corporate social responsibility, sustainability, leadership, and knowledge transfer. Some fundamental ideas are crucial to organizational effectiveness and sustainable growth. The network analysis highlights the significance of five essential concepts: knowledge management, sustainability, innovation, intellectual capital, and corporate social responsibility, via a network of significant co-

occurrences. In addition to technology transfer, organizational concepts such as knowledge, management, leadership, and entrepreneurship play a significant part in the study. Identifying particular clusters is facilitated by ensemble community detection and cluster analysis of related topics. Based on group keywords, two clusters of knowledge management procedures promote sustainable development. An additional cluster relates to the firm's management techniques and style and the many strategic concerns that may be pertinent to the organization. The environmental effect and sustainability cluster emphasizes incorporating technology while evaluating sustainability.

According to the report, a solid knowledge management approach incorporating knowledge exchange and transfer is vital for sustained development. Furthermore, leadership and corporate social responsibility programs should encourage collaboration, creativity, and sustainability. In addition to emphasizing the need to integrate technology into sustainable development initiatives, the research highlights the necessity for effective management practices and strategic approaches to support new technologies.

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The Impact of Health Policy and Technology on Hospital Productivity Growth: Evidence from Italy

Rossana Fulgenzi*

Department of Mechanical and Aerospace Engineering University Sapienza of Rome
Via Eudossiana 18 - 00184 Roma (RM) Italy
Department of Information Engineering and Mathematics
University of Siena
Via Roma 56 – 53100 Siena (SI) Italy

Simone Gitto

Department of Information Engineering and Mathematics
University of Siena
Via Roma 56 – 53100 Siena (SI) Italy

* *Corresponding author*

Abstract

This work provides evidence of the impact that Recovery Plans (RPs) have had on the productivity growth of Italian hospitals from 2010 - 2019. Using the Malmquist TFP index, we decompose the hospital's productivity into technological and efficiency changes.
We find that the RPs have resulted in an increase in efficiency change, i.e. hospitals use their resources (physicians, nurses, other hospitals' employees and the number of beds) more efficiently. In contrast, technological change has dramatically declined because hospitals are not using financial resources to buy innovative tools and learn new techniques that could improve healthcare processes. So, austerity measures have certainly reduced healthcare expenditure by optimising inputs capital, but they have contained investment in Information and Communication Technology (ICT). These results confirm that a lack of innovation and development has a severe longer-term impact on productivity.

Keywords – TFP, productivity, health policy, health technology, Italy

Paper type – Academic Research Paper

1 Introduction

The rapid increase in healthcare costs has drawn the attention of managers and policymakers on containing health expenditures. Several efforts have been made to improve providers' efficiency: increase hospital competition, change the payment system, change the organizational model, and others. Policymakers may include productivity gains in hospital payment systems by providing premiums or penalties for those organizations that improve or worsen their performance over time. Managers may find useful to compare their organization with others, assess their relative position and implement corrections for improvements (Colombi et al., 2017).

Recent studies in different countries have argued that the growth in Total Factor Productivity (TFP) is due to a quality improvement rather than an increase in output volumes and to the reduction in hospital stays and the critical role played by health policies (Karmann and Roesel, 2017; Atella et al., 2019).

Karmann and Roesel (2017) argued that, in German federal states, the effect of such policies on TFP growth depends on the types of cost reimbursement: fixed daily rates or Diagnosis-related groups (DRG) funding. In each case, hospital size and specialization are the variables that are the essential sources of TFP growth. When the type of reimbursement is fixed daily rates, hospital size is positively correlated with hospital efficiency in terms of quality and quantity but is not associated with technological progress. The increase in capacity is inversely proportional to technological innovations: in other words, huge hospitals are less likely to innovate. The level of specialization, on the other hand, when the type of reimbursement is of the DRG type, leads to a productivity gain.

Atella et al. (2019) compare the productivity growth of the English and Italian healthcare systems. They find that the English productivity growth index increased by 10%, while the Italian National Health System (SSN) productivity increased by 5%. The authors suggest that different policy objectives are reflected in differential growth rates for the two countries. The attention paid to specific disciplines is directly proportional to the perceived quality in those disciplines. The more specialized a hospital is in treating a particular disease, the higher the likelihood of offering the best solution to the patient.

Many European governments have designed policies and reforms to reduce public spending, optimise and reallocate resources and raise funds. The impact of these reforms and policies on productivity has been evaluated in many studies.

Blank and Egging (2014) examined the role of the Dutch government and the policies it has implemented in the health sector. Using econometric time series analysis, they aim to understand whether adopting new laws and regulations has positively impacted Dutch hospitals' productivity from 1972-2010. Introducing a budget system to control healthcare expenditure significantly increased productivity but resulted in long waiting lists. In contrast, the subsequent liberalisation of the healthcare market, with the resulting abolition of budget restrictions and the associated rise in financial resources, decreased productivity, probably due to adaptation lags.

Using Total Factor Productivity (TFP), Aragón Aragón et al. (2019) tried to understand whether some hospitals in the UK's national health system (NHS) are more productive than others. The sample used for the analysis consists of 151 hospitals that have not undergone organisational change, merged with other existing hospitals, or ceased to function during the period analysed (2008 - 2013). They conclude that each hospital in the set follows a trend that indicates productivity increases in one year and decreases in the next, or vice versa. In other words, it is impossible to cluster the hospitals into good and bad performers.

Always considering the NHS, Valdmanis et al. (2017) focused their analysis on hospitals in Scotland, where several measures, such as better resource allocation and continuous reduction of waiting times and production costs, have been introduced since 2004 to improve patient care. They used a bootstrapped Malmquist approach to assess the differences in productivity (efficiency and technology change) in 43 general acute hospitals from 2003 to 2007. The main findings relate to technical change: if there are significant changes in one period, these will cause negative changes in the following period. In other words, a time lag exists between introducing a new technology and its total absorption in a hospital.

Among European countries, Italy has experienced wide-ranging changes in its healthcare sector as the Italian government has attempted to reduce the negative impact of healthcare expenditures on its budget deficit and public debt (De Nicola et al., 2014). Starting from these results, this paper assesses, through the use of the Malmquist Index, how healthcare policies and technological change influence the Italian healthcare systems. Malmquist index is calculated using efficiency scores obtained from non-parametric Data Envelopment Analysis.

For this reason, productivity change can be decomposed into technological change and efficiency change, underscoring that productivity depends upon the

state of technology and the efficacy with which technology is applied. The expected results would help investigate whether productivity in the hospital sector is growing and whether government policies and technological endowments can influence this productivity growth. In fact, we aim to have further insights into whether there is a direct proportionality relationship between hospitals' technological endowments and productivity growth.

2 The Italian National Health System

The Italian National Health System (SSN), established by Law n.833 of 1978, belongs to organizations that have alternatively adopted different corporate structures. Universality, equity, and legality are the fundamental principles, which require strengthening the capacity to operate as a community-based system designed for and with people. Until 2001, the Italian Government distributed funds for health care to individual regions based on the size and age of the local population. The reform adopted in 2001 allowed the Italian regions and the autonomous provinces to be administrative and fiscal independent in the health decisions and expenses with the constraint of guaranteeing a package of standard health services (the so-called *Livelli essenziali di assistenza).* However, this decentralization and exceptional funding emanated by the central government to reduce social and economic disparities, may encourage an opportunistic behaviour of management, which quickly needed to balance their budgets due to their limited health service performance and severe deficit (Ricciardi and Tarricone, 2021). In 2006 the cumulative deficit from healthcare spending reached six billion euro (Depalo, 2019). The central government was forced to impose specific Recovery Plans (RPs), which are still active in about 8 of 21 regions with a considerable health budget deficit (Guccio et al., 2022). The RPs are agreements between the Italian Government and the regions with significant deficits in the health accounts. They were introduced by the national budget law for 2007 and were compulsory for regions with a deficit greater than 5% (Bordignon et al., 2019). The RPs aim to curb the growth of health expenditures and deficits and have a duration of three years. Regions must therefore be able to protect the health of their citizens while maintaining a balanced budget by rationalising expenditure.

However, if the regions fail to meet the plan's objectives, the plan is automatically renewed for three years. Moreover, in the case of a large deficit, the

central government can appoint a commissioner, who is made responsible for the effective implementation of the plan. Until now, ten Italian regions have experimented with RPs. Some of them (*Sardegna* and *Liguria*) came out almost immediately, others (*Piemonte*) came out after a more extended period, and others were (and still are) commissariats for the entire period. Table 2 shows the evolution of the RPs in the Italian regions; many have resorted to the Commissioner's intervention.

Table 1 Evolution of RPs in Italian regions

Region	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Abruzzo	RPC	RPC	RPC	RPC	RPC	RPC	RPC	RP	RP	RP
Basilicata	X	X	X	X	X	X	X	X	X	X
Bolzano	X	X	X	X	X	X	X	X	X	X
Calabria	RP	RPC	RPC	RPC	RPC	RPC	RPC	RPC	RPC	RPC
Campania	RPC	RPC	RPC	RPC	RPC	RPC	RPC	RPC	RPC	RPC
Emilia Romagna	X	X	X	X	X	X	X	X	X	X
Friuli Venezia Giulia	X	X	X	X	X	X	X	X	X	X
Lazio	RPC	RPC	RPC	RPC	RPC	RPC	RPC	RPC	RPC	RPC
Liguria	X	X	X	X	X	X	X	X	X	X
Lombardia	X	X	X	X	X	X	X	X	X	X
Marche	X	X	X	X	X	X	X	X	X	X
Molise	RPC	RPC	RPC	RPC	RPC	RPC	RPC	RPC	RPC	RPC
Piemonte	X	RP	RP	RP	RP	RP	RP	X	X	X
Puglia	X	RP	RP	RP	RP	RP	RP	RP	RP	RP
Sardegna	X	X	X	X	X	X	X	X	X	X
Sicilia	RP	RP	RP	RP	RP	RP	RP	RP	RP	RP
Toscana	X	X	X	X	X	X	X	X	X	X
Trento	X	X	X	X	X	X	X	X	X	X
Umbria	X	X	X	X	X	X	X	X	X	X
Valle d'Aosta	X	X	X	X	X	X	X	X	X	X
Veneto	X	X	X	X	X	X	X	X	X	X

Note: RP = standard recovery plan; RPC = presence of the commissioner; X = no recovery plan in force

Since our dataset covers a period between 2010 to 2019, this work assesses whether the recovery plans promoted by the Government have stimulated regional health productivity growth.

The Italian National Health System began an extensive reorganization process for local and hospital health services to rationalize healthcare expenditures by reducing healthcare staff and beds, especially for the regions under RPs (Ferrè, 2012). While many studies suggest that the primary financial objective has been achieved without negative effects (Bordignon et al., 2019; Giancotti et al., 2020), others argue that cost reduction has decreased specific efficiency indicators (Depalo, 2019; Arcà et al., 2020; Guccio et al., 2022). More than ten years after the introduction of the plans, we want to analyze their impact on hospital productivity contributing to the debate in the literature.

Using an econometric approach, Bordignon et al. (2019) suggest a good performance of RPs, at least from the financial point of view. The public health expenditure decreased significantly by about 28 euros per capita in regions subject to RPs and 92 euros in regions under RPCs without any significant effects on health services utilization and health outcomes. However, they argue that there is a lag period of two years before experiencing the RP's positive effects. As a confirmation of this, Giancotti et al. (2020), analyzing a sample of 41 Italian public hospitals from 2010 to 2013, affirm that reforms reached their aim of decreasing public health spending without weakening hospital efficiency. In the regions subjected to RPs, total deficit spending was reduced to 0.3 billion euros in 2016 from 4.1 billion euros in 2007. In addition, using Data envelopment analysis (DEA) and the Malmquist index, they show that RPs produced positive effects on technological change, scale efficiency, and overall productivity. Conversely, Depalo (2019) provides strong evidence for a positive correlation between reduced healthcare expenditure and mortality rates. A counterfactual analysis confirms that between 2007 and 2009, austerity measures caused a slight increase in mortality rates. He also shows that the reduction in health expenditure is inversely proportional to the reduction in hospital admissions, i.e., the more significant the cost reduction, the lower the volume of hospital admissions. These findings are confirmed by Arcà et al. (2020), who collected and analyzed a panel dataset for 21 Italian regions, from 2004 to 2014. They argue that the health expenditure cuts resulted, on average, in a 3% rise in avoidable deaths among men and women. Finally, Guccio et al. (2022), using a panel of 547 hospitals over the period 2003-2010, find that RPs increased the technical inefficiency of hospitals in the regions covered by the policy. They also conclude that the policy has affected the public sector more than the private sector. The rest of the paper

is organized as follows. Sections 3 and 4 describe the empirical strategy and data, respectively. Section 5 discusses the results. Section 6 provides a brief conclusion.

3 Methodology

In this study, we calculate the variation in productivity using the Malmquist productivity index. This index is constructed as ratio of distance functions. Let $x = (x_1, \ldots, x_N) \in R_+^N$ denote a vector of inputs and $y = (y_1, \ldots, y_M) \in R_+^M$ be an output vector. The production technology T consists of all feasible (x, y) and is defined by:

$$T = \{(x, y) : x \ can\ produce \ \ y\} \#(1)$$

Here we define the output distance function directly on the technology as in Shepard (1970). The output distance function is defined on the technology T as:

$$D(x, y) = \inf\left\{\theta : \left(x, \frac{y}{\theta}\right) \in T\right\}, \qquad \#(2)$$

i.e., as the "minimal" feasible contraction of the output vector, given an input vector.

Let t and $t + 1$ denote two time periods and let $D_o^t(x^t, y^t)$ be the value of the output distance function related to the technology in the period t and the input-output vector in the same period. Let $D_o^t(x^{t+1}, y^{t+1})$ be the value of the distance function for the input-output vector of period $t + 1$ and the technology at time t. The output-oriented Malmquist productivity index considering the t-period as reference technology is defined as:

$$M_o^t = \frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)}, \#(3)$$

Since we want to assess whether the reduction in health expenditure due to RPs still hurts productivity, we calculate the output-oriented Malmquist index. The latter allows us to measure how much output quantities can be proportionally expanded without altering the input quantities used. Inspired by Caves et al. (1982) we define the output-oriented Malmquist index as the geometric mean of (3) at period t and $t + 1$; i.e.,

$$M_o(x^t, y^t, x^{t+1}, y^{t+1}) = \left(\frac{D_o^t(x^{t+1},y^{t+1})}{D_o^t(x^t,y^t)} \frac{D_o^{t+1}(x^{t+1},y^{t+1})}{D_o^{t+1}(x^t,y^t)}\right)^{\frac{1}{2}}. \#(4)$$

We use the data envelopment analysis (DEA) to compute Malmquist productivity indices. This allows to exhaustively partition the Malmquist productivity index into useful component measures. In particular, the index can be decomposed into a technological change and an efficiency change component (Färe et al., 1998). The first source of productivity results from a shift in production technology and measures the hospital's ability to produce more (or less) with a given vector of input quantities. The second source of productivity results from a movement towards production technology and measures the hospital's ability to make a more efficient use of its inputs and exploit the available technology.

4 Data and Variables

The data used for the analysis were obtained from the Italian Ministry of Health. The period is from 2010 to 2019. We analyse the productivity of Italian hospitals during the years they benefited from the bailout and evaluate the efficiency of the region that opted out of the bailout. The sample is constituted by 429 hospitals in 2010 and 346 hospitals in 2019. Table 3 shows, for each of the Italian regions, the numbers of hospitals in each of the five management types represented in our sample for 2010 and 2019: Aziende Ospedaliere (AOs), teaching hospitals (THs), non-profit hospitals (NPs), Ospedali a Gestione Diretta (OGDs) and institutes for scientific research and treatment (IRCSSs).

Table 2: Distribution of Hospital Types over Regioni

	2010						**2019**					
Region	AO	TH	NP	OGD	IRCSS	**TOT.**	AO	TH	NP	OGD	IRCSS	**TOT.**
North:												
Piemonte	5	3	2	20		**30**	3	3	2	18		**26**
Valle D'Aosta				1		**1**				1		**1**
Lombardia			5	30	14	**49**			4	27	14	**45**
Veneto	1	1	5	21	1	**29**	1	1	4	9	1	**16**
Bolzano				4		**4**				4		**4**
Trento				4		**4**				3		**3**

Friuli Venezia Giulia	1	2		8	1	**12**				7	2	**9**
Liguria	1		1	6	2	**10**			2	6	2	**10**
Emilia Romagna	1	4		14	1	**20**		4		14	1	**19**
Central:												
Toscana		4		22		**26**		4		21		**25**
Umbria	2			7		**9**	2			7		**9**
Marche	2			11	1	**14**	1	1		5	1	**8**
Lazio	3	4	7	27	3	**44**	2	5	7	21	2	**37**
South:												
Abruzzo				14		**14**				8		**8**
Molise				4	1	**5**					1	**1**
Campania	8	2	3	30	1	**44**	6	3	3	25	1	**38**
Puglia		2	2	28	2	**34**		2	2	24	3	**31**
Basilicata	1			5		**6**	1			1		**2**
Calabria	4			13		**17**	4			10		**14**
Sicilia	5	3	1	29	1	**39**	4	3	2	15	1	**25**
Sardegna	1	2		15		**18**	1	2		12		**15**
North	9	10	13	108	19	**159**	4	8	12	89	20	**133**
Central	7	8	7	67	4	**93**	5	10	7	54	3	**79**
South	19	9	6	138	5	**177**	16	10	7	95	6	**134**
TOTAL	35	27	26	313	28	**429**	25	28	26	238	29	**346**

Note: Aziende Ospedaliere (AOs), teaching hospitals (THs), non-profit hospitals (NPs), Ospedali a Gestione Diretta (OGDs) and institutes for scientific research and treatment (IRCSSs).

Table 2 shows that the number of AOs and OGDs decreased significantly from 2010 to 2019. This reduction, as argued by Guccio et al. (2022), is due to the strict cost containment strategy, which resulted in institutional reorganisation through hospital mergers, particularly a 40% reduction in the number of AOs (OASI, 2021). Giancotti et al. (2020) assert that from 2010 to 2013, to reduce public expenditure, many hospitals were subject to aggregation processes and mergers. Except for *Basilicata* and *Sardegna*, all the regions in the South area are subject to recovery plans and the number of AOs and OGDs has fallen by 15.8% and 31.2%, respectively. The other regions covered by the plans are *Piemonte*, and *Lazio*. *Piemonte*, which left the plan in 2017, confirms the reduction of AOs and OGDs, by 40% and 10%, respectively. *Lazio*, still subject to the recovery plan, exhibits a reduction of 33.3% in AOs and IRCSSs and 22.2% in OGDs.

After eliminating the observations with missing values, the final sample consists of a balanced panel of 271 observations. We specify four inputs (physicians,

nurses, other employees, and number of beds) and three outputs (number of inpatients, number of outpatients and number of surgical procedures). The inputs and outputs are expressed in terms of physical quantities because no reliable data are available. The physician input is measured by the number of salaried physicians in each hospital. Similarly, the nursing input is given by the number of nurses; other employees are measured as the total number of employees in a hospital, minus numbers of physicians and nurses. The number of beds is the sum of outpatient and inpatient beds. Outpatient beds consists of the number of beds for outpatients, while inpatient beds number of beds available for treatment of inpatients. The number of beds provides a proxy measure for capital, which is otherwise difficult to measure. Using beds as a proxy for capital is typical in hospital studies (Grosskopf et al., 2004; Aletras et al., 2007; De Nicola et al., 2014): (i) the reduction in beds means the cut in healthcare costs; (ii) the reduction of this capital input implies inefficient use of resources.

The included outputs are inpatients, outpatients, and surgical procedures. In the hospital sector, the main output is inpatients, but not all inpatients who arrive at the hospital require the same attention and service. That is why it is necessary to adjust the hospital production in terms of complexity, using the case mix index (CMI) (Ferreira and Marques, 2014). For this reason, the number of inpatients and the number of surgical procedures are adjusted by multiplying them by a hospital case-mix index (CMI) to weigh output quantities by the intensity of treatment received.

Table 3: Description and role of variables

Variable	Description	Role of variables
Physicians	Total number of hospital physicians	Input
Nurses	Total number of hospital nurses	Input
Other employees	Total number of employees in a hospital, minus numbers of physicians and nurses	Input
Number of beds	Total number of hospital beds, obtained as the sum of outpatient and inpatient beds	Input
Number of inpatients	Total number of patients admitted to hospital	Output
Number of outpatients	Total number of patients not admitted to hospital	Output
Number of surgical procedures	Total number of hospital surgical procedures	Output

Table 4 provides summary statistics for our dataset of Italian hospitals. We calculated the median and the mean for each input and output variable. The median is a more robust estimator of the central value. If an outlier is present, the mean changes drastically, while the median remains close to the central value of the original statistical distribution (de Nijs and Klausen, 2013). In the regions subject to recovery plans, the medians of physicians and nurses increased slightly by 13.5% and 12.33%, respectively. Instead, the median for other employees and beds, decreased by 4.44% and 9.54%, respectively. The slight increase in physicians and nurses may be because many years have passed since the signing of the RPs, and the regions have improved their deficit condition, starting to unfreeze staff turnover. However, a minimal reduction in the number of beds is still evident. In the regions not subject to recovery plans (NRP regions), the median of inputs increased between 2010 and 2019. Those for physicians increased by 37.3%, nurses by 28.1%, other healthcare staff by 35.7% and beds by 3.9%. Concerning RP regions, the medians of the inpatients and outpatients have decreased by 2.15% and 16.7%, respectively; conversely, the median of surgical procedures has increased by 35.5%. Therefore, austerity measures are still visible in the lack of growth of beds and the reduction of the number of hospital admissions. In the NRP regions, all the medians' outputs have increased significantly. The median with the highest increase was for surgical procedures (27.1%).

Table 4 Descriptive statistics of output and input variables

		RP regions		**NRP regions**	
		Year			
Inputs		**2010**	**2019**	**2010**	**2019**
Physicians	Median	137	155.5	212	291
	Mean	207.9	227.8	268.4	343.6
	S.D.	194.71	200.04	202.45	238.37
	Min.	49	49	49	53
	Max	1,277	1,484	1,080	1,004
Nurses	Median	296	332.5	514.5	659.5
	Mean	431.7	470.1	673.1	842.5
	S.D.	377.89	425.84	521.55	640.47
	Min.	86	94	71	124
	Max	2,149	3,771	2,391	3,067
Other employees	Median	214	204.5	375.5	509.5
	Mean	333.3	329.2	574	713.3
	S.D.	382.08	415.76	523.95	586.42
	Min.	56	52	37	74
	Max	2,904	4,206	2,760	2,892

	Median	241	218	387	402
	Mean	317.8	312.2	492.8	521.5
Beds	S.D.	239.51	236.05	320.568	356.4692
	Min.	24	46	76	69
	Max	1,838	2,014	1,792	2,115
Outputs		**2010**	**2019**	**2010**	**2019**
	Median	8,127	7,952	14,518	15,282
	Mean	11,252	10,638	17,331	18,340
Inpatient	S.D.	9,594.03	9,343.91	13,046.43	13,555.02
	Min.	1,200	783	2,240	2,103
	Max	64,673	67,124	66,255	72,531
	Median	899	749	1,757	2,043
	Mean	1,383	1,152	2,227	2,542
Outpatient	S.D.	1,421.38	1,213.41	1,827.72	2,027.87
	Min.	124	101	138	253
	Max	11,080	8,435	10,287	11,784
	Median	8,496.62	11,511	14,710.20	18,697
	Mean	15,867.34	18,824	19,875.80	26,827
Surgical procedures	S.D.	19,777.71	22,599.52	19,036.90	25,299.46
	Min.	85.55	1,409	773.7	1,637
	Max	142,494.27	160,237	109,894.40	173,200

5 Results

5.1 Malmquist TFP's results

We analyse the evolution of hospital productivity during the period 2010-2019 to evaluate if the regions subject to recovery plans have improved their hospital performance. In Table 5 we distinguish between hospitals located in regions involved in RPs and those in regions that were not involved. In addition, we observe the evolution of *Piemonte* to understand the effects of this region that has left RP during the period of analysis. They show that the slight growth in TFP was due to an increase in the efficiency change (EC) component. Overall, there is a decreasing in productivity between 2010-2019, but RP regions show an improvement in the efficiency change component. This means that during the period 2010-2019, hospitals used their inputs (physicians, nurses, medical staff, and beds) and available technologies more efficiently. By contrary, there is a decreasing in the technological change, that results in a worse overall productivity. Regress in technology could be considered abnormal, but it is consistent with the system's pressure to reduce costs, which does not allow for the introduction of innovation and new technologies into the healthcare system in the long period. Information and Communication Technologies (ICT) are

valuable tools to support the traceability of healthcare processes and the exchange of information between the different actors involved in the patient care pathway. Different information systems can help healthcare providers in their daily activities, but the austerity measures have limited the vision of challenging ICT solutions based on cloud computing, mobile health, and innovative ICT digital solutions. Even if, as shown by Ciaschini et al. (2016), a strict ICT investment policy can significantly improve care ability and cost containment expenditure without worsening the quality and efficiency of health services.

Moreover, previous studies underline that a close alignment between the technology introduced by the hospital and technological needs raised by physicians and nurses hospital administrators are necessary (Ancarani et al., 2016). However, organizations take time to absorb newly developed technologies and become confident with innovative processes (Liao et al., 2016). In addition, complementary investment in learning and reorganizations are needed to exploit all the opportunities from ICT. Our result suggests that finding a trade-off between reducing health expenditure and improving the technologies employed may be complicated.

Our findings are in line with the aim of the recovery plans, i.e. to reduce healthcare expenditure and optimise resources. But as a consequence, the hospitals are losing productivity in the long period. Therefore, cost-cutting has optimised and made resource use more efficient, but it is not a sustainable strategy over the years. According to Giancotti et al. (2020) and using a smaller sample, austerity measures caused an increase in technological change and productivity up to 2013. Using a larger and updated sample, we obtain different results: the technological change worsens productivity in the long run. Instead, we confirm that RP and NRP regions have yet to recover the technical inefficiency also described by Guccio et al. (2022). On the other hand, considering the regions that have left their recovery plans, hospitals in *Piemonte* continue to make more efficient use of resources and increase productivity.

Table 5 Descriptive statistics of the Malmquist (M), efficiency change (EC) and technological change (TC)

		2010 - 2019				
		Median	Mean	S.D.	Min	Max
RP regions	M	0.937	0.958	0.216	0.542	1.530
	EC	1.001	1.048	0.252	0.561	1.777
	TC	0.939	0.921	0.096	0.575	1.104
NRP regions	M	0.905	0.937	0.219	0.474	1.582
	EC	0.981	1.007	0.212	0.521	1.820
	TC	0.932	0.934	0.114	0.643	1.292
Piemonte	M	1.003	1.037	0.162	0.823	1.542
	EC	1.016	1.077	0.291	0.820	2.089
	TC	1.020	0.985	0.097	0.732	1.104

6 Conclusions

In this paper, we analyze the productivity of Italian hospitals after the introduction of recovery plans. Using the Malmquist TFP index, we have conducted an analysis to assess the impact of recovery plans to the productivity growth of the Italian regions from 2010 to 2019. Our findings confirm that the average Malmquist TFP has decreased in both groups of regions (RPs and NRPs). However, in RP regions, a significant improvement is visible in the efficient change components. In other words, hospitals under recovery plans use resources more efficiently. Moreover, we find that the decline in productivity is attributable to technological change. Then, reducing health expenditure and improving technology are trade-off because the introduction and the adoption of new technologies requires significant time and complementary investments in learning and reorganization. This paradox causes significant productivity losses in the long run. A new idea to support policy decisions is understanding from which year productivity worsens to find the right trade-off between efficient use of resources and hospital productivity.

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Organizational Learning for Cybersecurity

Silvia Colabianchi*

Sapienza University of Rome
Via Ariosto 25, 00185, Rome

Francesco Costantino

Sapienza University of Rome
Via Ariosto 25, 00185, Rome

Fabio Nonino

Sapienza University of Rome
Via Ariosto 25, 00185, Rome

Giulia Palombi

Sapienza University of Rome
Via Ariosto 25, 00185, Rome

* *Corresponding author*

Abstract

The increasing connectivity and digitization of organizations have made cybersecurity a top priority. Organizations have become highly dependent on integrated systems and data, exposing them to cyber threats that can lead to economic and reputational losses. The COVID-19 pandemic has further highlighted vulnerabilities in cybersecurity systems across sectors. In particular, there has been a recent focus on the role humans play in this scenario by turning out to be both a possible source of vulnerability and a mitigating factor. To manage this, organizations must focus on establishing a culture of cyber security awareness by promoting policies, standards, and users' behaviors from an organizational learning perspective.

Employees' education is one of the components needed to create such a culture, hence training programs on cybersecurity have a crucial role.

However, the effectiveness and sustainability of training programs depend on including a variety of stakeholder groups to identify and mitigate cost and efficacy concerns, adopt accessible training techniques, employ trainers with relevant expertise, and address psychological obstacles like trainee guilt and shame. A balanced human-machine approach is needed to maximize the benefits of connectivity while minimizing cyber risks. Overall, cybersecurity training requires an ongoing, collaborative, and flexible process tailored to

each organization's context. Today, there is no consensus on the most effective and appropriate cybersecurity training methods. This research investigates available cybersecurity awareness types of training and provides guidelines for developing good organizational training programs in increasingly digital environments.

Keywords – digitalization, cyber resilience, human factor, training 4.0, innovation

Paper type – Academic Research Paper

1 Introduction

Today hyper-connected environment has resulted on one side in an appreciable increase in productivity, efficiency, and system integration, on the other side it has raised the number of possible hazards. Organizations are now highly dependent on data and information from their integrated systems (Corallo et al., 2022). This has exposed not only company secrets but also the personal information of millions of consumers resulting in both economic and reputational loss for organizations. For these reasons, cybersecurity has become a top priority for organizations that find themselves working in an increasingly dynamic and real-time optimized system (Colabianchi et al., 2021).

Furthermore, the fast and global spread of the coronavirus pandemic exposed the vulnerabilities of existing cybersecurity systems (Ramadan et al., 2021). IT has played an important part in all activities, serving as the focal point of operations in healthcare, business, education, industry, and other fields (Weil & Murugesan, 2020). However, there are several disadvantages, including increased cybersecurity threats and hazards, performance issues due to a significant rise in workload, and business continuity.

These considerations fit into a context in which the debate is developing as to which is the human role in cybersecurity. Specifically, the increasing complexity and interconnectedness of these systems are forcing researchers to investigate in which part humans are a threat or an opportunity for organizational cybersecurity (Zimmermann & Renaud, 2019). On one side human error is the weakest link in security. On the other side, recent studies addressed humans as flexible and able to rapidly judge and attack, stressing the importance of a continuous synergy among humans and machines to pursue cybersecurity effectiveness. Especially, in the context of small-medium organizations focusing on what employees do, what they need, and how they react to cybersecurity tools can be the first line of

defence. With education, awareness, and reminders, humans will make informed decisions by interacting with technology (Annarelli et al., 2022). Therefore, the increase of support people, training, and documentation are the most obvious options. There is a need to invest in programs that increase cybersecurity awareness and the ability to identify and manage a cyber threat (Chowdhury, Katsikas, et al., 2022).

However, the added costs associated with staff, software, building space, and so on make this option unfeasible for many organizations (Zhang et al., 2021). In addition, when talking about cybersecurity, shame, and reticence can have a strong impact. When workers realize that they have caused a cybersecurity incident they often feel guilt and shame, trying not to communicate the error and making the consequences of the attack worse (Renaud et al., 2021). It is therefore very difficult for organizations to structure a training program that is effective, attractive, and sustainable economically.

There emerges from the literature an absence of a common line on which training methods are most effective and appropriate for the organizational context in which one operates. Organizations need to carry out considerations about the profiles of the people who will support the training, the continuing increase in the severity of social engineering attacks, the variety of 4.0 training techniques ranging from the most classic face-to-face training to gaming and platforms that make use of Virtual Reality tools (Alhashmi et al., 2021; Angafor et al., 2020). For this reason, in the present study, we aimed at reviewing the training methods available in the literature to train workers on cyber risks and to discuss the aspects that need to be explored to develop an appropriate and sustainable training program.

To accomplish our objective, we explored the literature on the topic of cybersecurity awareness training programs and detailed relevant aspects for the implementation of effective cybersecurity training programs. Finally, a discussion and conclusions are provided.

2 Organizational learning

Organizational learning is defined as "the process of improving actions through better knowledge and understanding" (Fiol & Lyles, 1985) and is one of the most vital competencies of an organization. It is a dynamic process that involves the acquisition, interpretation, and application of new knowledge and skills to

improve an organization's performance and effectiveness (Argote & Miron-Spektor, 2011). It is a continuous process that involves both individual and collective learning, as well as the creation and sharing of knowledge across different levels and functions within an organization. It supports the idea of the organization as a whole learning and adapting its behavior and it is largely adopted in management sciences with the specific intent to change employee behavior (Ojha et al., 2018). The benefits of organizational learning are numerous, including improved innovation, greater adaptability to change, enhanced problem-solving capabilities, and increased employee engagement and satisfaction (Garvin et al., 2008). Moreover, organizational learning can also contribute to the development of a learning culture, where learning is seen as a core value and a source of competitive advantage.

Most of the organizational learning theories are based on the idea that people have mental processes and their reactions in situations (including planning, implementing, and reviewing their actions) depend on these processes.

Training is one of the most significant practices for the organizational learning process since a good training program makes individuals elaborate information and turns it into useful organizational knowledge (López et al., 2006)

3 Social engineering attack and cybersecurity awareness

Social engineering defines a type of cyber-attack in which the attacker exploits human vulnerabilities through social interaction to breach the security goals of cyberspace elements (such as infrastructure, data, resources, users, and operations) (Wang et al., 2020). Using influence, persuasion, deception, and manipulation, the victim is induced to trust the attacker who will obtain data that were supposed to be confidential, without respecting principles of integrity, availability, controllability, and audibility (Fang, 2018).

Social engineering attack goal comprises network intrusion, gaining unauthorized access to information or systems, denial of service, data exfiltration, modification, fabrication or destruction, infrastructure sabotage, and obtaining physical access to restricted areas (Wang et al., 2021).

The key for mitigate social engineering cyber risk by making employees less vulnerable is to establish a cybersecurity awareness culture within the organization through specific cyber awareness training programs aimed at

informing what security threats are and acting responsibly to avoid potential risks (Van Niekerk & Von Solms, 2010).

One of the most famous social engineering attacks is called phishing and has the aim to obtain confidential information from a target (Bhavsar et al., 2018). It consists of sending a message or email that appears as being from a respectable administration, seems urgent, and invites the targets to open a website that is a duplicate of the original one. In the message, the victims are asked to provide personal information on the website that, unfortunately, is stolen by the attackers who can use it, for example, to enter the system to steal money or to obtain precious confidential data (Desolda et al., 2022).

Considering the specific context of cybersecurity training which embodies technological, normative (policy/standard), and behavioral aspects, and its central role in organizational learning, this study aimed at reviewing the existent cybersecurity training methods (focusing on cybersecurity awareness training) and providing direction for their improvement.

4 Methodology

Key terms such as cybersecurity awareness, social engineering, training, course program, etc. were identified to search for training programs available in the literature. The database used for the search was Scopus. Once the key articles were identified, the articles cited and those that cited them were also explored. Our focus in this study is on cybersecurity training rather than cybersecurity education. With the term cybersecurity training the authors will refer to those practices which provide employees with the specific knowledge necessary for their job responsibilities, utilizing more practical methods such as seminars, workshops, and game-based activities. To be effective, training must be designed to be relatable to employees and aligned with the business context of the organization, while also utilizing a variety of delivery methods (Chowdhury, Katsikas, et al., 2022). To classify the identified training programs, we relied on two classifications known from the literature. The first is that of (He & Zhang, 2019) that propose best practices for implementing successful cybersecurity training programs. The second is the one proposed by (Gkioulos & Chowdhury, 2021), which analyzes aspects such as the tools used and the performance of the training.

5 Results

The provided classification combines the aspects highlighted in the previous section and ranks the identified items providing an overview of cybersecurity training programs. It is worth specifying that this study is limited to these types of programs that focus on the human component and not on technological and network protection aspects.

The table is structured as follows:

- *Reference*: article in which we can find an outline of the training program
- *Description*: a brief description of the training program
- *Delivery method*: We divide the delivery methods into 5 categories. These identify the type of training used to transfer the training content.
    - Conventional methods: refer to on-site courses; paper-based teaching and exercises; presentations.
    - Online/Software-based: refers to online courses; cloud-based training material and software; email tests.
    - Game-based: refers to serious games and training based on competition.
    - Video-based: refers to educational videos.
    - Simulation/Virtualization-based: refers to testbeds, simulation platforms, and exercises.
- *Topology*: by this term, we refer to the type of tool used to conduct training. Specifically, we identify:
    - Video
    - Presentations (e.g. PowerPoint)
    - Virtual Reality
    - Augmented Reality
    - PowerPoint
    - Digital Intelligent Assistant
    - A mix of the above
- Attributes:
    - Accountability: refers to the responsibility of individuals to prevent cybersecurity breaches through knowledge and diligence. This involves rewarding employees who report suspicious activity and making cybersecurity a part of every

employee's performance goals, rather than punishing those who do not comply.

- Fun: refers to a cybersecurity training approach that uses engaging and entertaining content to educate employees about the importance of cybersecurity. Gamification is also used.
- Hands-on: refers to a cybersecurity training approach that actively involves employees in identifying and reporting suspicious activity. Role-playing and testing are also included.
- Interactivity: refers to a cybersecurity training approach that encourages active engagement from employees. This involves storytelling, encouraging employees to ask questions and share experiences and share the material. Role-playing and scenarios, such as phishing attacks, are also used to provide practical experience.
- Just-in-time training: refers to a cybersecurity training approach that provides material to employees as they join the company and when they fail test emails. When employees fall for test emails, they are informed that they failed and directed to specific materials or videos to review and learn from their mistakes.
- Personalization: refers to a cybersecurity training approach that is tailored to the specific needs and concerns of individual employees. This approach seeks to personalize the training to address the specific needs and concerns of each employee, making it more relevant and engaging.
- Reinforcement: refers to a cybersecurity training approach that emphasizes regular assessments and micro-trainings to keep employees informed and engaged. This includes staying up-to-date with new and emerging threats and sending regular email blasts about threats.
- Relevancy: refers to a cybersecurity training approach that provides tailored curricula to individuals based on their specific roles and responsibilities. This includes providing department or application-specific advice that explains the importance of cybersecurity in simple terms that employees can understand.

This approach seeks to make the training more engaging and effective by providing employees with practical tools and knowledge that they can apply in their work.

- Reward: refers to the action of giving out incentives when someone answers a question posed to the group or wins a game or simulation.
- Strengths: strengths of the training program solution
- Weakness: limits identified in the training program solution.

Table 1 - Cybersecurity Training Programs

Ref.	Description	Delivery Method	Topology	Attributes	Strengths	Weakness
(Jin et al., 2018)	A game-based learning method for cybersecurity education using Virtual Reality.	Game-Based; Simulation / Virtualization-based	Virtual Reality	Fun; Relevancy	The content was well memorized due to the high experiential training. Participants enjoyed the training and felt involved.	Suitable only for employees who already have technological skills. Difficult to navigate a large number of procedures and rules.
(Tan et al., 2020)	Adaptive awareness training system which updates its knowledge base. A list of questions is presented to the user by a Digital Intelligent Assistant.	Online and Software Based	Digital intelligent assistant	Interactivity; Personalization; Reinforcement; Relevancy	Always be up-to-date and be able to do micro-training when desired. Interacting with a virtual assistant reduces the shame employees might feel when interacting in class.	It can be tedious, time-consuming, and cognitively demanding to have to answer all these questions frequently.
(Nagarajan et al., 2012)	A first-person interaction game where the user is confronted by an adversary or problem and must take a proper course of	Game-Based	Video	Fun; Interactivity; Personalization;	The users are engaged and motivated. Participants reported good results.	Might be difficult to tailor the game to each organization and users' skills and attitude

	action or else is penalized severely.					
(Nagarajan et al., 2012)	A virtual online environment with provided limited resources. Good choices result in a richer environment and additional resources, bad choices result in diminishing resources.	Simulation/ Virtualization - based	Video	Fun; Interactivity; Personalization; Relevancy; Reward	The users are engaged and motivated. Rewards were a good incentive.	Time and cost-consuming to adapt the simulation environment to different organizational scenarios
(Angafor et al., 2023)	A scenario-based virtual incident response exercise. Before the exercise users are given procedures and rules to handle cyber incidents.	Conventional Methods; Simulation / Virtualization-based	Presentations; Video	Hands-on; Interactivity	Reported good results in terms of identifying threats and strategies to handle incidents. Users felt engaged and empowered.	Need continuous updates with new threats and vulnerabilities. Focused on specific users and roles.
(Tonkin et al., 2022)	A multiplayer cybersecurity education platform for evaluation and learning. The game offers an entertaining and competitive setting that includes educational elements. It allows	Online and Software Based; Game-Based	Video	Fun, Interactivity, Reward	Improved level of engagement, communication, immersion, flexibility, and interactivity.	Currently, lack of a testing scenario and limited learning content. Hard to use for technologically unskilled users.

	players to participate with random individuals in open rooms or closed/reserved rooms with groups.					
(Jayakrishnan et al., 2022)	A simulated game that replicates a business environment where executives need to make decisions on investments, allocating resources for cybersecurity.	Online and Software Based; Game-Based	Video	Hands-on; Interactivity; Personalization; Relevancy.	Employees seeing a system highly customized to their role were found to be more engaged and interested.	Limited learning content.
(Eze & Hawker, 2022)	A cyber awareness platform prototype that enables users to evaluate their existing knowledge and skills, and then tailor a training program based on evaluation results and their roles.	Online and Software Based	Video	Personalization; Relevancy	The role-sensitive solution was considered beneficial in the training program.	Limited learning content and roles available for assessment.
(Sheng et al., 2007)	A game to train users not to fall for phishing attacks.	Game-Based	Video	Fun; Interactivity; Hands-On	The users were engaged and reported good results.	Might result hard to use for people without basic knowledge of the topic and technology.

6 Discussion e Conclusion

On the one hand, the analysis of cybersecurity training programs confirms the lack of a single approach that guides organizations in defining which parameters are useful for implementing effective training. On the other hand, what emerges from the analysis of strengths and weaknesses is how effective training turns out to be in relation to the context variables in which it is found (e.g., level of preparedness of the users, size of the organization, learning objective to be pursued, etc.) (Venables, 2021). Another interesting aspect that emerges from the literature is a generally shared view that emphasizes the importance of moving toward training that uses innovative technologies, yet multiple papers show how organizations are still anchored to traditional training methods even in sectors with high cyber risk (Chowdhury, Nystad, et al., 2022) or in context of Small and Medium Enterprises (Johansson et al., 2022).

Finally, an interesting aspect found in several studies is to integrate training with the completion of questionnaires for self-assessment of cybersecurity behavior. The questionnaires presented in previous relevant studies can be classified according to their characteristics such as the number of items it contains, whether it is based on a theoretical framework, its accessibility to the general public, the year of publication, the topic covered, and the target recipients or audiences. Among Information Security Awareness questionnaires, the most used are: UISAQ = Users' Information Security Awareness Questionnaire (Velki et al., 2014); BCISQ = Behavioral- Cognitive Internet Security Questionnaire (Velki & Strossmayer, 2019); OSBBQ = Online Security Behavior and Beliefs Questionnaire (Schaffer & Debb, 2019); HAIS-Q = Human Aspects of Information Security Questionnaire (Parsons et al., 2014).

Overall, the study underlined how in the context of cybersecurity, organizational learning can play a crucial role in improving an organization's overall security posture. The increasing frequency and sophistication of cyber attacks have made it imperative for organizations to not only invest in technical security solutions but also in training their employees to be more vigilant and proactive in recognizing and responding to potential security threats. By fostering a culture of continuous learning and innovation, organizations can enhance their cybersecurity posture and better protect themselves against emerging threats and vulnerabilities. Research has shown that organizations that prioritize

organizational learning are better equipped to deal with the evolving cybersecurity landscape (Mikalef et al., 2019).

The solutions classified highlight that cybersecurity training programs must provide an active role of the learner and attention to his/her behavioral aspects. Moreover, context-based characteristics are vital to tailor a training program to the specific organizational environment in which the training is needed. Indeed solutions should be designed and implemented in a way that aligns with the organization's culture, values, and strategic objectives. This requires a thorough understanding of the organization's learning needs and preferences, as well as the use of innovative and engaging training methods that promote active learning and knowledge transfer. In this scenario, the use of technology-enhanced learning solutions, such as simulation, gamification, and virtual reality, can further enhance the learning experience, increase engagement and retention rates, and contribute to the processing of information into useful organizational knowledge and behavioral processes following an organizational learning perspective.

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Urban Resilience: Which Relationships with Sustainability and Well-Being?

Michela Colacicco

Politecnico di Bari
Department of Mechanics, Mathematics & Management
Via Orabona 4, 70126 Bari, BA, Italy

Angela Nuzzi*

Politecnico di Bari
Department of Mechanics, Mathematics & Management
Via Orabona 4, 70126 Bari, BA, Italy

Pierpaolo Pontrandolfo

Politecnico di Bari
Department of Mechanics, Mathematics & Management
Via Orabona 4, 70126 Bari, BA, Italy

Barbara Scozzi

Politecnico di Bari
Department of Mechanics, Mathematics & Management
Via Orabona 4, 70126 Bari, BA, Italy

* *Corresponding author*

Abstract

Resilience is a widely accepted concept to which scholars and policymakers refer to address the complexity of urban systems. Many frameworks to measure urban resilience already exist. In this paper, the main urban resilience frameworks (i.e., City Resilience Index, Resilience Maturity Model, and the Sendai Framework for Disaster Risk Reduction) are analysed to shed light on the common dimensions they present. Additionally, the relationship between (i) resilience and (ii) sustainability and well-being in the urban context is investigated. To do so, Agenda 2030 for Sustainable Development, scaled at city level, and the Equitable and Sustainable Territorial well-being framework are compared with the urban resilience frameworks. In the urban domain, the concepts of resilience, sustainability and well-being partially overlap. Many dimensions (e.g., health, economic prosperity, environmental protection) are considered in the resilience as well as in sustainability and well-being frameworks. Such dimensions are indeed measured with the same or very

similar metrics. However, an in-depth analysis of dimensions and indicators showed some interesting differences. The paper provides knowledge advancement on the topic of resilience in the urban context and highlights those aspects that policymakers should consider so as to pursue resilience as well as sustainability and well-being goals in the initiatives they implement to face emerging urban challenges.

Keywords – Resilience, Urban system, sustainability, measurement

Paper type – Academic Research Paper

1 Introduction

In recent years, resilience has become a central topic in studies spanning from ecology to psychology (Meerow and Stults, 2016; Zeng et al., 2022). In the urban domain, resilience, i.e. the capacity of an urban system to absorb, resist, transform, change, recover and prepare, in relation to events (such as shocks, stresses, hazards, disasters) that have occurred or may occur (Figueiredo et al., 2018) is one of the concepts to which both scholars and policymakers refer to address the complexity of urban systems (Béné et al., 2014; Meerow et al., 2016). For those reasons, urban resilience has been widely studied by academia and practitioners, as well. A plethora of definitions (Meerow et al., 2016; Nunes et al., 2019a; Nunes et al., 2019b) and several frameworks – e.g., the City Resilient Index (ARUP, 2014) – to guide in the construction and measurement of urban resilience have been developed. The existence of multiple definitions and frameworks may confuse urban decision-makers who need to operationalize and measure the resilience of their city so as to properly plan future initiatives as well as assess and report the effects of the implemented policies.

Some studies point out that resilience has been often examined in association with sustainability, another crucial topic, but "without a precise meaning and as an additional label attached to pre-existing research" (McPhearson, 2014; Zhang et al., 2018). Urban resilience and sustainability are different concepts that partially overlap, so it is relevant to investigate their relationship (Bautista-Puig et al., 2022).

The goal of the paper is twofold, namely (i) clarifying the concept of resilience in the context of cities and (ii) investigating to what extent such a concept overlaps with the one of sustainability. To this aim, three main frameworks to assess and measure resilience of urban systems, namely the City Resilience Index

(ARUP, 2016), the Resilience Maturity Model (Hernantes et al., 2019) and The Sendai Framework for Disaster Risk Reduction (UNDDR, 2015), are analysed. Each framework focuses on specific resilience dimensions, so involving different aspects that should be considered to build a resilient urban system.

The three resilience frameworks are compared to identify the dimensions of urban resilience as well as the performance and metrics to assess it. Then, the identified dimensions, performance, and metrics are compared with those used to assess urban sustainability. To do so, two frameworks – Agenda 2030, a well-known framework for sustainable development (United Nations, 2015), and Equitable and Sustainable Territorial Well-being (Bellantuono et al., 2021), a framework aimed at measuring well-being at local level – are considered. The latter framework is considered as it focuses on well-being, which is a concept very much intertwined with sustainability.

The study is organized as follows: after a Section that focuses on the concept of urban resilience and its theoretical evolution, the extant literature addressing the relationship between the concepts of (i) urban resilience and (ii) urban sustainability and well-being is discussed; then some well-known frameworks to measure urban resilience, sustainability and well-being of urban areas are presented and the methods adopted to make the comparison explained. Finally, results of the study are presented, and future research avenues are drawn.

2 Resilience in the urban domain

Nowadays, academics and practitioners widely acknowledge the three-dimensional conceptualization of resilience in the urban domain (Nunes et al., 2019a) which stems from the conceptual evolution from the engineering and ecological resilience toward the socio-ecological resilience.

In 1970s Holling (1973) adapted the notion of engineering resilience to ecosystems which are dynamic systems with multiple stable states. Holling (1973) describes resilience as the ability of an ecological system to persist and continue functioning after a disturbance. Successively, Holling (1996) broadened the concept of resilience by distinguishing ecological resilience, defined as the ability of an ecosystem to withstand and absorb a temporary disturbance and fully recover its functionalities; ecological resilience refers to the magnitude of absorbed disturbance and implies that multiple states of equilibrium exist. This means that the system can bounce forward to a new state of equilibrium,

accepting that it is not always possible or desirable to return to previous conditions. More recently, the concept of resilience evolved into the socio-ecological resilience, an evolutionary perspective that recognizes that a system is in constant change with or without external disturbance and refers to the ability of the socio-ecological system to change, adapt, and, crucially, transform in response to stresses and strains (Davoudi et al., 2012; Folke, 2006). This evolutionary perspective of resilience stresses the adaptive capacity, self-organization, and transformability that a resilient system should have. The evolutionary resilience perspective seems to be well accepted by institutional organizations with respect to the urban context. For instance, OECD defines urban resilience as "the capacity of cities to absorb, adapt, transform and prepare for shocks and stresses along the economic, social, institutional and environmental dimensions, with the aim of maintaining the functions of a city and improving response to future shocks (Figueiredo et al., 2018)"; in a similar manner, urban resilience is defined as "the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation" by the Intergovernmental Panel on Climate Change (2014).

The concept of resilience is tending towards a theoretical stabilization, in which 'social-ecological resilience' can be understood as the most integrative and relevant resilience conceptualisation in urban domain; however, this theoretical evolution does not imply that the three conceptualizations cannot coexist in urban resilience research. The adoption of one conceptualization does not exclude the others but is rather mutually reinforcing (Nunes et al., 2019b).

The literature has addressed tensions and inconsistencies in the notion of urban resilience and its application in practise (Grafton et al., 2019; Meerow et al., 2016; Moser et al., 2019). From a theoretical standpoint, the malleability of the concept of resilience gives to urban resilience an important function as a "boundary object" to foster collaboration between disciplines and stakeholders. As cities are complex systems that require the expertise of multiple disciplines and stakeholders, the possibility to resort to boundary objects is quite relevant (Brand et al., 2006; Meerow et al., 2019; Sharifi et al., 2017). On the other hand, the ambiguity of the resilience concept makes its operationalization extremely challenging (Olsson et al., 2015; Serbanica et al., 2023). Additionally, although in the urban studies the concept has become a buzzword (Chelleri et al., 2021;

Stumpp, 2013), the confusion and overlap with other similar concepts (as sustainability) undermines the concept's utility and its practical application (Anderies et al., 2013; Zhang et al., 2018).

3 Resilience, sustainability and well-being of urban systems: literature overview

To understand how extant literature addressed the relationship between (i) resilience and (ii) sustainability and well-being in the urban domain, a literature review was conducted. A search query combining the terms "sustainability" and "well-being" with those related to the domain of interest ("urban resilience", "city resilience", "resilient city", "community resilience") was applied to the Title/Abstract/Keyword section of Scopus database (only English documents and journal articles were considered). A total number of 778 studies were retrieved and then screened to eliminate those not relevant to the goal of the review.

Some scholars argue that the concepts of resilience and sustainability are used in interchangeable way when referred to the urban context (Saunders et al., 2015; Stumpp, 2013), particularly in urban policy agendas and frameworks (Chelleri et al., 2021; Elmqvist et al., 2019; Suárez et al., 2016).

In other studies, resilience is considered as a component of or, to some extent, related to sustainability (Davidson et al., 2019; Pirlone et al., 2020; Zeng et al., 2022). A survey conducted by Chelleri et al. (2021) revealed that for both researchers and practitioners was hard to establish a clear distinction between the two concepts; most of them thought that resilience and sustainability have different, but not conflicting goals, and, in particular, resilience is a prerequisite of sustainability. Resilience is indeed considered critical for attaining and achieving sustainability goals in urbanized contexts (Cartalis, 2014; Tainter et al., 2014) and in some cases used to operationalize some aspects of sustainability (Pickett et al., 2014). In this view, urban sustainability is a societal goal aimed to achieve a balance between urban development and long-term protection of the environment, to guarantee an inclusive, democratic, economically equitable development of local areas. It refers to a desirable state characterized by environmental and human well-being as well as intra- and intergenerational equity (Delgado-Ramos et al., 2017). In the urban context, sustainability is an approach to envision the future and defines urban systems' desirable outcome (such as the enhancement of human well-being, social equity or environmental

integrity). Urban resilience is seen as a problem-solving oriented process (Zhang et al., 2018) that concerns the recovery from environmental, societal or economic shocks or chronic challenges (Zeng et al., 2022) by leveraging, among the others, on self-organization capabilities (Rogov et al., 2018; Zhang et al., 2018). This perspective was effectively synthesized by Redman (2014) - who argues that sustainability prioritizes outcomes and resilience prioritizes processes - and Rogov (2018) who states that sustainability sets the objectives whereas resilience is considered a means to achieve these objectives. Such studies also stress the different timescale considered when dealing with resilience and sustainability initiatives. Resilience focuses on short-term characteristics of urban system behaviour and it operates as adaptive cycles initiated by shocks (Rogov et al., 2018). Urban sustainability focuses on long term sustainable development goals (Zhang et al., 2018) and seeks to address the major challenges facing the society with a more long-term perspective (Rogov et al., 2018). Based on this view, Rogov et al. (2018) asserts that urban sustainability, as a long-term goal, is based on systems' resilience that, in the short-term, is revealed within sudden shocks and negative stress factors.

By studying in depth the resilience strategy of cities participating in the 100 Resilient Cities Programme, Serbanica et al. (2023) provided a conceptual model that depicts the relationship between urban sustainability and resilience by identifying some latent challenges or dimensions that are at the intersection of the two concepts (e.g., shifting macro-economic trends, inadequate health system and infrastructure failure) on which policy decision makers should operate to increase both resilience and sustainability. However, in the same study, the scholars also argued that it is possible to distinguish resilience from sustainability based on the type of hazards, shocks or stresses they focus. In particular, according to Serbanica et al. (2023), urban resilience has a strong focus on hazards (disruptive events) and acute shocks (as landslides, earthquakes, drought, cyber-attacks) that may cause serious human, material, economic and environmental losses and impacts; urban sustainability, on the other hand, is associated with long-term, chronic and cumulative stresses, namely climate change (environmental perspective), economic inequality (economic perspective) and lack of cohesion (social perspective). Other studies investigate the differences among the two concepts. For example, redundancy, which is a crucial characteristic of resilient socio-ecological systems (Figueiredo et al., 2018; Zeng et al., 2022), could reduce competitiveness of a city in economic or environmental

terms (Chelleri et al., 2015). Also, whereas sustainability pays considerable attention on balancing economic, environmental and social justice goals, the urban resilience agenda is commonly critiqued for not adequately addressing social equity goals (Fitzgibbons et al., 2019; Muñoz-Erickson et al., 2021; Zeng et al., 2022). Muñoz-Erickson et al. (2021) by surveying researchers, government practitioners and members of civil and business groups in nine cities of America and Latin America found that equity and sustainability are rarely associated with resilience.

Although resilience and sustainability operate on different time scales and are considered, to some extent, different concepts, most scholars agree with the perspective of resilience and sustainability as related concepts. As by 2070, almost 60% of the world population is projected to live in urban areas and be exposed to both chronic and emerging urban challenges (UN Habitat, 2022), frameworks and methodological approaches to face such challenges should integrate both resilience and sustainability (Chelleri et al., 2015; Delgado-Ramos et al., 2017) and urban policy makers should pay equal attention to both urban resilience and sustainability to achieve a rational urban development (Zhang et al., 2018).

In the literature, less attention is devoted to the investigation of the relationship between urban resilience and well-being. McCrea et al., (2014) argue that well-being is a state of the community, whereas resilience is a process; well-being at the community level is defined as 'the satisfaction with the local place of residence taking into account the attachment to it, the social and physical environment, and the services and facilities' (Forjaz et al., 2011) and it refers to a state to evaluate important aspects of a community at a given point in time, whereas the resilience of a urban community is the process to responding and adapting to changes and disasters with the aim of maintaining or enhancing community well-being over the time. Community resilience and well-being are vaguely defined concepts that often overlap as they share some dimensions, e.g., community engagement and cohesion (McCrea et al., 2016). Community well-being is a high relevant but underused concepts to assess the community response to resilience processes and strategies (Gibbs et al., 2015). A conceptual model to explain the relationship between community resilience and wellbeing (McCrea et al., 2014) considers resilience and well-being as distinct constructs and states that they can be related in different ways (for instance, good resilience processes may be triggered by a sense of poor well-being; differently a good

level of community well-being and a sense of community may trigger active resilience processes).

4 Materials and Methods

In this Section, we briefly describe three resilience frameworks, namely City Resilience Index, Resilience Maturity Model and Sendai Framework for disaster risk reduction, and two sustainability and well-being frameworks, namely 2030 Agenda for Sustainable Development and Equitable and Sustainable Territorial Well-being.

4.1 City Resilience Index

City Resilience Index (CRI), developed by Arup (2014) and supported by The Rockefeller Foundation, has been designed to enable cities to measure and monitor the multiple factors that contribute to their resilience. Particularly, it captures the views of the poor and vulnerable groups as they normally suffer more severely the impacts of disruptions and failures. CRI identifies four fundamental dimensions, namely Health and Well-being, Infrastructure and Ecosystems, Leadership and Strategy, Economy and Society, 12 goals (Table 1) and 52 indicators that contribute to a richer articulation of resilience measurement. Additionally, for each of the 52 indicators, CRI provides 156 metrics (ARUP, 2016) so as to measure different aspects of urban resilience. The full set of CRI metrics is reported in Appendix (Table A1).

Table 1. The City Resilience Index (CRI) – Dimensions and Goals

Health and Wellbeing	
Description	Goal
Relates to people - the health and well-being of people living and working in the city. It considers if a city can meet basic need (food, water and shelter) and to safeguard the health of its population through its normal and emergency healthcare provisions	Minimal human vulnerability: minimising human vulnerability enables individuals and household to achieve a standard of living which goes beyond mere survival. This relates to the extent to which everyone's basic needs (food, water and sanitation, energy, and shelter) are met
	Diverse livelihoods and employment: livelihoods opportunities and support mechanisms (finance, skills training, accrue savings, business support and social welfare) enable citizens to proactively respond to changing conditions in their city without compromising their wellbeing and helping them survive in times of crisis
	Effective safeguards to human health and life: integrated health facilities and services, and responsive emergency services are fundamental to maintain public health and treat chronic and acute health problems

Economy and Society	
Description	Goal
Relates to the organisation of cities - how social and economic systems enable urban populations to live peacefully, and act collectively. It includes the systems that enforce law and order and the environment within a city that creates collective identity and mutual support	Collective identity and mutual support: active community engagement, strong social networks and social integration enable individuals, communities, and the city government to create a city with a strong identity and culture
	Comprehensive security and rule of law: a comprehensive and contextually appropriate approach to law is needed to reduce and prevent crime and corruption in a city. A transparent justice system enables cities to promote citizenship in daily life. Furthermore, well planned, and resourced law enforcement facilitates peaceful recovery reducing crime-related injury, fatality, and stress
	Sustainable economy: A robust economic system is fundamental to sustaining the investment that a city needs and contributes to create contingency funds that are critical to respond to emergencies and unexpected events
Infrastructure and Ecosystems	
Description	Goal
Relates to place - the quality and the robustness of infrastructure and ecosystems that provide critical services, protect, and connect every citizen, particularly under shock or stress situations	Reduced exposure and fragility: working together, both natural and man-made assets help to improve protection against severe conditions, avoiding injury, damage, or loss. A comprehensive understanding of the hazards and risks to which a city is exposed is needed to develop integrated strategies that combine sound environmental stewardship, robust design and maintenance of man-made infrastructure, and enforcement of appropriate building codes and regulations
	Effective provision of critical services: Well-maintained systems are better able to accommodate abnormal demand, withstand unusual pressures and continue functioning specially during times of stress. Well-established management practices enable infrastructure managers to better restore disrupted services
	Reliable mobility and communications: reliable communications and mobility support rapid mass evacuation and widespread communication during emergencies as well as connecting places, people, and services
Leadership and Strategy	
Description	Goal
Leadership and Strategy is underpinned by knowledge. A resilient city learns from the past and takes appropriate action based on evidence which means effective leadership, inclusive governance and evidence-based decision-making are required	Effective leadership and management: leadership is a key ingredient in encouraging individuals and communities to act during challenging times. Trusted individuals, multi-stakeholder consultation, evidence based decision-making and disaster risk reduction activities enable city to respond to shocks and stresses
	Empowered stakeholders: underpinned by information, education, knowledge and provision of early warnings, individuals and communities take appropriate decisions and act better under shocks and stresses
	Integrated development planning: the creation and implementation of integrated plans enable to deal with multidisciplinary issues (climate change, disaster risk reduction or emergency response) as well as ensure alignment of individual projects and programmes

4.2 Resilience Maturity Model

Resilience Maturity Model (RMM), developed within the project Smart Mature Resilience For More Resilient cities in Europe (SMR: Smart Mature Resilience Project, 2015), helps cities assessing the current resilience maturity level as well as identifying and prioritizing policies useful to improve in terms of resiliency (Hernantes et al., 2019). RMM identifies four dimensions: Leadership and Governance, Preparedness, Infrastructure and Resources, Cooperation. Each dimension contains subdimensions related to specific aspects of resilience (Table 2). For each of them, the framework provides some indicators to measure the resilience maturity level (Appendix - Table A2). RMM lays out five stages of maturity, namely Starting, Moderate, Advanced, Robust and Vertebrate that cities go through in the resilience building process.

Table 2. Resilience Maturity Model – dimensions. Adapted from: (Resilience Maturity Model Handbook, 2018)

Dimensions	**Subdimensions**
Leadership and Governance (L)	Municipality, cross-sectorial and multi-governance collaboration (L1) Legislation development and refinement (L2) Learning culture (learning and dissemination) (L3) Resilience action plan development (L4)
Preparedness (P)	Diagnosis and Assessment (P1) Education and Training (P2)
Infrastructure and resources (I)	Reliability of Critical Infrastructures (Cis) and their interdependences (I1) Resources to build up resilience and to response (I2)
Cooperation (C)	Development of partnerships with city stakeholders (C1) Involvement in resilience networks of cities (C2)

4.3 Sendai Framework for Disaster Risk Reduction

Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR or Sendai Framework) (UNDDR, 2015), developed based on the Hyogo Framework for Action 2005-2015, was adopted at the Third UN World Conference on Disaster Risk Reduction in 2015. It aims to achieve by 2030 the substantial reduction of disasters' risk and losses in lives, livelihoods, and in the economic, physical, social, cultural, and environmental assets of persons, businesses, communities, and countries. Differently from the CRI and RMM frameworks which focus on resilience at city level, the Sendai Framework addresses resilience at national level. The Sendai Framework outlines four priorities for action (Table 3) and seven global targets to reduce disaster risks, losses in terms of human lives as well as

any economic, social, and environmental damages. The global targets (Table 4) may be clustered in two groups: targets from A to D concern specific outcomes, targets from E to G concern inputs or enablers. Each target is supported by one or more indicators (Sendai Framework Indicators, 2015). A total number of 38 indicators is provided to measure the achievement of resilience global targets (Appendix - Table A3).

Table 3. Sendai Framework for Disaster Risk Reduction – Priority for action

Priority	Description
Understanding disaster risk	Disaster risk management needs to be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment
Strengthening disaster risk governance to manage disaster risk	Strengthening disaster risk governance at the national, regional and global levels for prevention, mitigation, preparedness, response, recovery and rehabilitation is necessary
Investing in disaster reduction for resilience	To enhance dimensions of resilience (e.g., economic, social, health) public and private investment in disaster risk prevention and reduction are essential. Such investments contribute to salve lives, prevent, and reduce losses and ensure effective recovery and rehabilitation
Enhancing disaster preparedness for effective response, and build back better in recovery, rehabilitation and reconstruction	Making nations and communities resilient to disasters is fundamental. The constant growth of disaster risk combined with the lessons learned from the past disaster, indicates the need to prepare ahead the recovery, rehabilitation and reconstruction phase as an opportunity to "build back better"

4.4 2030 Agenda for Sustainable Development

2030 Agenda for Sustainable Development (United Nations, 2015) signed by the governments of the 193 member countries of the United Nations and approved by the UN General Assembly, outlines 17 Sustainable Development Goals framed within a broader action programme consisting of 169 linked targets, to be achieved by 2030. In the path towards sustainability, it is fundamental acknowledging the decisive role played by cities. They centralize the majority of the population and resources to be invested in fighting poverty, inequality and climate change. In 2017 UN Sustainable Development Solutions Network (SDSN) launched the U.S. Cities SDG Index in which Agenda 2030 goals and targets are scaled at the city level. Such a set of indicators was developed to support mayors, other local government leaders and the U.S. federal government to assess and measure the status of sustainable development through the lens of cities and Metropolitan Areas. In 2018, Eni Enrico Mattei Foundation, in collaboration with

UN SDSN network, published the Italia SDGs City Index, a similar set of indicators to be used by majors to assess the sustainability level of Italian cities so as to support policymaking. The Index outlines 46 indicators that cover 16 goals (SDSN, 2020). Table A4 in Appendix reports the full list of indicators. With the same purposes a similar list of indicators was also proposed in 2019 Index and Dashboards Report for European Cities (SDSN, 2019a). The indicators were used to assess European cities' sustainability. The indicators included in the U.S. Cities SDG Index resemble those reported in Agenda 2030; those adopted at the European and Italian level were in some cases modified to take into account the available local official statistics.

4.5 Equitable and Sustainable Territorial Well-Being

In 2010, the Italian National Institute of Statistics (ISTAT), together with the National Council for Economics and Labour (CNEL), launched the Equitable and Sustainable Well-being Project to measure the quality of life at the national level (ISTAT, 2010). The framework includes a set of 153 indicators that covers 12 different domains of well-being e.g., Economic Prosperity, Health, Education (Monte et al., 2022). To consider differences at local scale and the territorial distribution of well-being (Bellantuono et al., 2021), in 2018 ISTAT published the Benessere Equo e Sostenibile dei Territori (BESdT, in English: Equitable and Sustainable Territorial Well-being) that provides a set of indicators to assess well-being for Italian provinces and metropolitan cities. The current version of the framework outlines 70 indicators spanning into 11 domains (compared to 12 of the equitable and sustainable well-being at national level) namely: Health, Education and training, Work and reconciliation of living times, Economic and well-being, Social relations, Policy and institutions, Safety, Landscape and cultural heritage, Environment, Innovation, Research and creativity, Quality of services (ISTAT, 2022). BESdT indicators are listed in Table A5 in Appendix.

5 Results and Discussion

To achieve the paper's goal, a comparison between the frameworks described in Section 4 was carried it. Such a comparison was conducted in two stages. First, the three resilience frameworks were compared so as to identify possible common dimensions; the comparison was based on the indicators provided by the three frameworks. As CRI and RMM frameworks consider city as unit of

analysis, while the Sendai Framework addresses resilience at national level, to compare the three frameworks, the indicators provided by the Sendai Frameworks were scaled at urban level. Second, the resilience indicators provided by the three resilience frameworks were compared with those used to assess urban sustainability and well-being. To that aim, Agenda 2030 and BES, both scaled at city level, were considered. As the BESdT framework, as already mentioned, is specifically referred to the Italian territorial context, Italia SDG City Index (rather than the U.S. or European SDG index) was considered.

In this Section, the results of the study are presented and discussed. We discuss the dimensions common to the examined resilience frameworks. Then, overlaps and differences that arise in the comparison with sustainability and well-being frameworks are discussed by examining the indicators and metrics used.

5.1 CRI, RMM and Sendai: common dimensions

The analysis and comparison of indicators provided by the three resilience frameworks reveal that there are some commonalities between the resilience aspects addressed by the frameworks. Although similar indicators are included in different dimensions in the three frameworks, in many cases, they measure the same aspect of resilience. As shown in Table 5, four dimensions are common to the three frameworks (i.e., Risks identification and Assessment, Shock and disasters Management, Effective Emergency management, Knowledge Sharing and cooperation with other entities); three more dimensions are common to CRI and RMM frameworks (i.e., Services and Critical Infrastructures to address security and legal requirements, Insurance Coverage, and Resilience Plan). All resilience frameworks provide metrics to assess the urban systems' ability to identify and assess potential risks to which may be exposed: the Sendai framework provides more generic indicators (for instance, adoption and implementation of local disaster risk reduction strategies in line with national strategies), whereas CRI and RMM more specifically measure the ability of an urban system to assess risks: for instance, CRI provides metrics measuring the percentage of residential dwellings in high risk areas; both CRI and RMM focus on the measurement of the revision of risk assessment plans, so providing urban systems with some indicators to measure their ability to be prepared to face potential risks. Additionally, the three resilience frameworks include indicators to measure the urban system's ability to manage shock and disasters; however, the approach adopted to measure such a

dimension is different: Sendai focuses on the quantification of disasters' damage in terms of lives, livelihood and economic losses; differently, CRI and RMM look at the protection mechanisms that the urban system should have to be able to recover from a shock or a disaster (for instance, CRI provides metrics to measure the percentage of population which has access to disaster recovery mechanisms or the percentage of city's hospitals with back-up electricity generators); similarly, RMM measures the resources allocated to adopt infrastructures to face shocks. In other words, CRI and RMM address the resilience as ability of the urban system to react and recover from a shock, the Sendai mostly allows urban system to quantify the entity of damage occurred. Another common dimension among the three frameworks regards the emergency management: the Sendai framework only measures the capacity of urban systems to implement a pre-emptive evacuation after an emergency situation; CRI and RMM frameworks assess the capacity of the urban system to be prepared to an emergency situation (e.g., RMM measures the resources deployed to training, CRI measures the budget allocated to emergency planning). The cooperation with international and external networks of organizations are aspects taken into account by RMM and Sendai. Aspects related to knowledge sharing of resilience practices are considered both in RMM and CRI.

In conclusions, CRI and RMM frameworks are more similar: they adopt a common approach to the management of shocks and disasters (as they both assess the ability of urban system to recover from them) and to the emergency management (as they both assess the urban systems' capacity to be prepared to emergency). Additionally, CRI and RMM frameworks present two dimensions (Services and Critical Infrastructures to address security and legal requirements and Insurance coverage) that are addressed in similar manner and for which both frameworks provide very similar metrics.

Table 5. Comparison of CRI, RMM and Sendai Frameworks

Common dimensions	**CRI – metric**	**RMM – indicator**	**Sendai - Indicator**
Services and Critical Infrastructures to address security and legal requirements	Percentage of houses which have passed national safety standards (H&W)	Percentage of CIs that fulfil legal requirements (I1M5)	
	Percentage of city population with authorized electrical service (H&W)		
	Percentage of buildings within the city with planning permission records (I&E)		
Insurance Coverage	Percentage of buildings with insurance cover for high risk hazards relevant to the city (H&W)	Percentage of infrastructures and population with insurances (I2A1, I2A3, I2A4, I2R1,I2T2)	
Risks Identification and Assessment	Percentage of city area for which a comprehensive exposure and vulnerability assessment has been undertaken within the past 5 years (I&E)		
	Number of years since last citywide critical asset assessment (I&E)		Number of countries that have multi-hazard early warning systems (G-1)
	Number of years since the last city-wide review of the adequacy of the city's protective infrastructure assets (I&E)		
	Percentage of residential dwellings within the city that are situated within high risk areas (L&S)	Number of assessments to identify weaknesses (P1S1)	Percentage of local governments that adopt and implement local disaster risk reduction strategies in line with national strategies (E-2)
	The number of times the 5 most significant hazards identified in the city's local risk profile have been assessed by multi-stakeholders in the last 5 years (L&S)		
	Number of years since		

	city hazard maps have been updated (L&S)		
	Number of reviews of city-wide emergency protocols undertaken in the past 5 years (H&W)	Number of revisions of CI risk assessment (I1M4)	Percentage of local governments having a plan to act on early warnings (G-4)
Shock and disasters Management – Damage quantification		Average time for CIs to return to normality (I1M3)	A-1 Number of deaths and missing persons attributed to disasters, per 100,000 population
			A-2 Number of deaths attributed to disasters, per 100,000 population
			A-3 Number of missing persons attributed to disasters, per 100,000 population
			B-1 Number of directly affected people attributed to disasters, per 100,000 population
			B-2 Number of injured or ill people attributed to disasters, per 100,000 population
			B-3 Number of people whose damaged dwellings were attributed to disasters
			B-4 Number of people whose destroyed dwellings were attributed to disasters
			B-5 Number of people whose livelihoods were disrupted or destroyed, attributed to disasters
			C-1 Direct economic loss attributed to disasters in relation to global gross domestic product
			C-2 Direct agricultural loss attributed to disasters
			C-3 Direct economic loss to all other damaged or destroyed productive assets attributed to disasters
			C-4 Direct economic loss in the housing sector attributed to disasters

			C-5 Direct economic loss resulting from damaged or destroyed critical infrastructure attributed to disasters
			C-6 Direct economic loss to cultural heritage damaged or destroyed attributed to disasters
			D-1 Damage to critical infrastructure attributed to disasters
			D-2 Number of destroyed or damaged health facilities attributed to disasters
			D-3 Number of destroyed or damaged educational facilities attributed to disasters
			D-4 Number of other destroyed or damaged critical infrastructure units and facilities attributed to disasters
			D-5 Number of disruptions to basic services attributed to disasters
			D-6 Number of disruptions to educational services attributed to disasters
			D-7 Number of disruptions to health services attributed to disasters
			D-8 Number of disruptions to other basic services attributed to disasters
Shock and Disasters Management – Recovery and protection mechanisms	Number of mechanisms in place to support local, small- and medium sized businesses following a disaster (H&W)	Percentage of businesses/CIs with contingency plans (P1S3)	
	Percentage of population which has access to disaster recovery mechanisms from shocks (H&W)	Resources allocated to adopt extraordinary infrastructures to face shocks (I1S3,	

	I1A1, I1T1)	
Number of days that city fuel supplies could maintain essential household functions (through alternative sources) (H&W)	Resources invested in preventive maintenance activities (I1M2)	
Percentage of population that could be served by city's access to stock of emergency shelters for 72 hours (H&W)	Number of maintenance procedures in each CI sector (I1M2)	
Percentage of population which can be supplied water by alternative methods for 72 hours during disruption (H&W)	Number of redundant systems-infrastructures per CI sector (I1M3)	
Percentage of city's hospitals with back-up electricity generators (I&E)		
Percentage of city's hospitals with back-up water supply to meet its needs for three days (I&E)		
Percentage of emergency responders with arrangements which enable them to communicate in an emergency (satellite phones, airwaves) (I&E)		
Percentage of city government data with secure back-up remote storage (I&E)		
Percentage of government databases protected by a dynamic proactive I.T. security system (I&E)		
De-rated capacity margin: the amount of excess electricity supply above peak demand (expressed as a percentage) (I&E)		
Percentage of infrastructure which relies on operational		

	technology protected by a dynamic proactive I.T. security system (I&E)		
	Percentage of government departments that have tested their own continuity arrangements in the last 2 years (L&S)		
Effective Emergency management	Percentage of hospitals that have carried out disaster preparedness drills in the last year (H&W)	Resources deployed for training exercises (P2S1, P2M1, P2A1, P2A2, P2A4, P2R2, P2T1, P2T2, P2T3)	
	Number of search and rescue trained emergency responders with collapsed structures expertise per 100,000 population (H&W)		
	Number of reviews of city-wide emergency protocols undertaken in the past 5 years (H&W)		
	Percentage of the police force which has undertaken disaster response training in the last 5 years (E&S)	Frequency of training exercises (P2S1, P2M1, P2A1, P2A2, P2R2, P2T1, P2T2, P2T3)	
	Emergency planning budget as a percentage of total city budget (E&S)	Number of trained volunteers (P2S2, P2R1, P2T3)	
	Number of times the city's multi-stakeholder emergency management strategy has been tested in the last 5 years (L&S)		
	Number of times multi-stakeholder emergency responders meet and undertake joint activities (e.g., exercises, risk assessment, plan reviews) per year (L&S)	Effectiveness of training exercises (P2S1, P2S3, P2M1, P2A1, P2A2, P2A4, P2R2, P2T2)	
	Number of times the emergency response centre capability has been tested (and successfully passed) in the last 5 years (for real or scenario) (L&S)	Existence of emergency plans that integrate stakeholders (C1S1, C1M1)	

	Percentage of citizens intended to be evacuated, which were successfully evacuated in the last disaster drill or disaster event in the last 5 years (L&S)		
Resilience Plan	Percentage of population that have made a household or a community resilience plan (L&S)	Resources dedicated to the development of the resilience action plan (L4S1, L4M1, L4A1, L4R1)	
		Number of updates of the resilience action plan (L4R1)	
		Percentage of local government budget spent on resilience building activities (L3S1, L3M1)	
Knowledge Sharing and cooperation with other entities	Number of training and knowledge sharing agreements with international networks (L&S)	Number of cooperation agreements with external governmental bodies and cities (L3T2)	F-1 Total official international support, (official development assistance (ODA) plus other official flows), for national disaster risk reduction actions
		Learning activities executed among stakeholders and with other cities (L3M2, L3T2)	F-2 Total official international support (ODA plus other official flows) for national disaster risk reduction actions provided by multilateral agencies
		Number of best practices shared among stakeholders (L3A1, L3R1, L3T1, L3T2)	F-3 Total official international support (ODA plus other official flows) for national disaster risk reduction actions provided bilaterally
		Effort taken to learn from what other stakeholders do to increase resilience (L3M2, L3A1, L3R1, L3T1, L3T2)	F-4 Total official international support (ODA plus other official flows) for the transfer and exchange of disaster risk reduction-related technology
			F-5 Number of international, regional and bilateral programmes and initiatives for the transfer

			and exchange of science, technology and innovation in disaster risk reduction for developing countries
			F-6 Total official international support (ODA plus other official flows) for disaster risk reduction capacity-building
			F-7 Number of international, regional and bilateral programmes and initiatives for disaster risk reduction-related capacity-building in developing countries

5.2 Resilience and Sustainability: similarities and divergences

The comparison of indicators provided by the three resilience frameworks with those reported in the sustainability and well-being frameworks reveals that resilience and sustainability partially overlap. As shown in Table 6, one dimension is common to all frameworks, i.e., risk identification and assessment. For instance, both Italia SDGs City Index and BESdT provide metrics that measure the population at risks of flooding. However, CRI, RMM and Sendai examine a full range of risks through specific indicators (e.g., percentage of residential dwellings in high-risk areas, number of assessments to identify weaknesses, adoption of risk reduction strategies). The Sendai Framework has only one more indicator in common with Italia SDGs City Index (i.e., number of deaths and missing persons attributed to disasters) and with BESdT (i.e., disruptions of basic services - in the specific case of BESdT, the basic service considered is electricity). However, the approach is different: the Sendai Framework measures disruptions to quantify damage due to disasters, BESdT assesses the quality of services offered at the city level (not necessarily under emergency conditions). RMM presents one more similarity with both the sustainability and well-being frameworks: RMM and BESdT measure the involvement of citizens in education or training activities (BESdT promotes participation in cultural activities, RMM promotes social, cultural, economic and environmental activities). RMM and Italia SDGs City Index measure alignment with national resilience and environmental sustainability standards, respectively.

A stronger overlap between resilience and sustainability emerges when CRI framework is considered. By comparing CRI with Italia SDGs City Index and BESdT, 12 and 21 correspondences are obtained, respectively. All three frameworks adopt perfectly overlapping metrics to measure well-being and health (e.g., life expectancy at birth and infant mortality rate), economy prosperity (e.g., GPD), environment and ecosystem protection (i.e., PM10 concentration, municipal waste production), safety and efficiency of critical services (e.g., the sustainability and well-being framework measure the number of deaths related to road transport, the CRI framework considers the mortality rate related to all type of transports); both CRI and BESdT include the interruption of basic critical services which is specifically addressed by measuring the number or the length of interruptions of the electrical service. Although measured by adopting slightly different metrics, the electoral participation and the level of education of the population are measured in all frameworks. Other aspects addressed by both the resilience and well-being frameworks concern the availability of hospital beds, gender equality at political level, the unemployment rate, the environmental protection rate of urban areas, number of murders committed, and number of charitable organizations.

The considered sustainability and well-being frameworks do not consider the importance of planning regular maintenance procedures for critical infrastructures and more generally do not consider the need for disaster planning and prevention which are assessed by the CRI and RMM frameworks. Resilience frameworks focus on stakeholder engagement, the creation of a sense of community and a culture of resilience, dimensions that are not relevant to sustainability and well-being frameworks. Furthermore, the lack of plans for cooperation with other cities facing similar risks and knowledge sharing, that are indicators considered by RMM, CRI and Sendai Framework, lead to further points of divergence among resilience and sustainability and well-being frameworks. The well-being of a society is also reflected in its way of inhabiting the land and taking care of its cultural heritage. The dimension of creativity is included only in the BESdT framework and is not reflected in any of the other analysed resilience frameworks.

Table 6. Comparison of resilience, sustainability and well-being frameworks

Italia SDSs City Index - indicator	BESdT- indicator	CRI- indicator	RMM - indicator	Sendai - indicator	Synthesis indicator
Economic suffering index (Goal1)		Percentage of population living below national poverty line (H&W)			Poverty
Life expectancy at birth (Goal3)	Life expectancy at birth (Health)	Average life expectancy at birth (years) (H&W)			Life expectancy at birth
Infant mortality rate (Goal3)	Infant mortality rate (Health)	Maternal mortality rate per 100,000 live births (H&W)			Infant mortality
Deaths and injuries in road traffic injuries (Goal 3)	Road accidents mortality rate (15-34 years old) (Health)	Transportation fatalities per 100 000 population (I&E)			Transport-related deaths
	Hospital beds per 10,000 inhabitants (Quality of services)	Hospital beds per 100,000 people (H&W)			Hospital capacity
Population with Isced 3 Middle School License (Goal 4)		Percentage primary education completion rates (L&S)			Completing education
	People with at least upper secondary education level (25-64 years old) (Education and training)	Percentage of adults with higher education as a percentage of total population aged 16-64 (E&S)			Completing education
	Women municipal councillors (Politics and institutions)	Women as a percentage of total elected to city-level office (E&S)			Gender equality

	Irregularities in electric power distribution (Quality of services)	Average length of electrical interruptions (I&E)		D-5 Number of disruptions to basic services attributed to disasters	Basic services interruptions
Average taxable income per capita (Goal 8)	Average disposable income per capita (Economic well-being)	GDP (PPP,$) per capita (E&S)			Gross domestic product
	Non-participation rate (Work and life balance)	City's unemployment rate (% of working-age population) (H&W)			Unemployment
	Youth's non-participation rate (Work and life balance)	Youth unemployment rate (percentage of youth labour force) (E&S)			Youth unemployment
	Average annual salary of employees (Economic well-being)	Average hourly compensation cost (wage + benefits) for an hour of labour (H&W)			Workers' wages
Mobility offer public transport (Goal 9)	Seat-Km of public transport networks (Quality of services)	Percentage of commuters using a travel mode other than a personal vehicle (as a percentage of total commuters) (I&E)			Public transport efficiency
PM10 (Goal 11)	PM10 Annual average concentration (Environment)	PM10 concentration (I&E)			PM10 concentration

Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population (Goal 11)				A-1 Number of deaths and missing persons attributed to disasters, per 100,000 population	Shock and disasters management
Municipal waste production (Goal 12)	Municipal waste generated (Environment)	Waste generation rate per capita (municipal solid waste, kg per capita per year) (I&E)			Municipal waste production
	Separate collection service for municipal waste (Quality of services)	Percentage of the city population with regular solid waste collection (I&E)			Waste collection management
Population exposed to flood risk (Goal 13)	Population at risk of landslides Population at risk of flood (Environment)	Percentage of residential dwellings within the city that are situated within high risk areas (L&S)	Number of assessments to identify weaknesses (P1S1)	E-2 Percentage of local governments that adopt and implement local disaster risk reduction strategies in line with national strategies	Risk identification and Assessment
Ecolabel licenses (Goal 15)			Number of certifications (L2A1, L2R1, L2T1)		Alignment with standards
	Protected natural areas (Environment)	Percentage of city area that has been officially recognised for environmental protection (including shorelines			Environmental protection

		down to low-tide mark) (E&S)			
Political electoral participation 2018 (Goal 16)	Voter turnout (Regional Councils) (Politics and institutions)	Voter participation in last municipal election (as a percentage of eligible voters) (E&S)			Electoral participation
	Intentional homicide rate (Safety)	Homicides per 100,000, per year (E&S)			Homicides
Broadband access (Goal 17)		Internet users (I&E)			Users with internet connection
	Non-profit organizations (Social relationships)	Number of charities operating in the city per 100,000 population (E&S)			Charitable organizations
	Participation in life-long learning (Education and training)		Number of trained volunteers (P2S2, P2R1, P2T3)		Citizen involvement

6 Conclusions

The existence of different definitions and frameworks to measure resilience may confuse urban decision-makers who need to develop policies and plans to increase urban resilience. To clarify the concept of urban resilience, three well-known resilience frameworks (CRI, RMM, and Sendai Framework) were analysed and compared. Some resilience dimensions common to the three frameworks were identified (e.g., Risks identification and assessment, Shock and disasters management, Effective emergency management, Knowledge sharing and cooperation with other entities). We found that while CRI and RMM share a common preventive approach to the management of shocks and disasters, the Sendai framework mainly focuses on the measurement of the entity of damages and losses occurred after a disaster.

The paper also discussed the relationship between (i) resilience and (ii) sustainability and well-being in the urban domain. The comparison, based on the

indicators provided by the three examined urban resilience frameworks and two sustainability and well-being frameworks, namely Italy SDGs City Index and BESdT, highlights that resilience and sustainability are partially overlapping concepts. The considered resilience and sustainability frameworks indeed provide the same indicators to measure aspects such as health, economic prosperity, environmental protection, safety and efficiency of critical services, and very similar indicators to assess some other aspects such as the level of education attained by population or the electoral participation. However, some differences also arise, e.g., the importance of planning and knowledge sharing. The leverage of culture, community sense, and stakeholder engagement, which are relevant dimensions/indicators in resilience frameworks, are of little relevance in sustainability and well-being frameworks.

From a theoretical perspective, the paper provides further insights into the concept of resilience and clarifies the relationship between resilience and sustainability and well-being in the context of cities. From a practical point of view, the results of the analysis can be used by policymakers to assess and monitor the resilience, sustainability and well-being of the urban system as well as define policies able to address such issues.

Despite their relevance, only few frameworks were examined and compared. Further research will include the analysis of other frameworks as well as the examination of resilience and sustainability indicators provided by academic studies. Based on that, the development of a comprehensive set of indicators, including resilience, sustainability, and well-being metrics will be developed.

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Appendix

Table A1. City Resilience Index – Indicators and metrics

CRI - Dimensions	CRI - Goals	CRI - Indicators	CRI - Metric
Health and wellbeing	Minimal Human Vulnerability	Safe and affordable housing	Number of homeless people per 100,000 population
			Percentage of houses which have passed national safety standards
			Percentage of population that could be served by city's access to stock of emergency shelters for 72 hours
		Adequate affordable energy supply	Average percentage of household income spent on fuel and electricity by the poorest 20 percent of the population
			Percentage of city population with authorized electrical service
			Number of days that city fuel supplies could maintain essential household functions
		Inclusive access to safe drinking water	Percentage of population that has access to safe and reliable water
			Percentage of population which can be supplied water by alternative methods for 72 hours during disruption
		Effective sanitation	Percentage of population with access to improved sanitation
			The number of years since the city's wastewater contingency plan was updated
		Sufficient affordable food supply	Percentage of malnourished children under five as a percentage of all citizens under five
			Average distance of the centre of the 20 percent most deprived neighbourhoods (LSOA level and the Index Measure of Deprivation) from a vegetable market or supermarket selling fresh food and vegetables
			Percentage per capita food reserves within city (including supermarket agreements) for 72 hours (percentage population which could be served)
	Diverse Livelihood and Employment	Inclusive labour policies	Average hourly compensation cost (wage + benefits) for an hour of labour (US Dollars)
			Percentage of population living below national poverty line
		Relevant skills and training	Percentage of people unemployed for more than 6 months who have access to a programme that is intended to improve their employment chances
			Job security: Probability to become unemployed (the number of people who were unemployed in this year, but were employed last year, divided by the total number of employed in last year, x 100 and expressed as a percentage)

		Local business development and innovation	Percentage employment change from the last year
			City's unemployment rate (% of working-age population)
			Number of new businesses registered within the city in past year, per 100,000 population
			Percentage of local businesses with female / minority owner
		Supportive financing mechanisms	Annual number of approved and regulated small business-loans or micro-credit per 100,000 population
			Percentage value of loans / credit provided to female / minority owned businesses as a percentage of overall loans
		Diverse protection of livelihoods following a shock	Percentage of buildings with insurance cover for high risk hazards relevant to the city
			Percentage of population which has access to disaster recovery mechanisms from shocks
			Number of mechanisms in place to support local, small- and medium sized businesses following a disaster
	Effective safeguards to human health and life	Robust public health systems	Percentage of children 12-23 months who have received specific vaccines for BCG, measles, and three doses each of DPT and polio vaccine (excluding polio 0 months) per poorest quintile of the population (percentage 12-23 year olds within poorest 20% population)
			Average life expectancy at birth (years)
			Drug-related mortality with drugs as primary cause of death per 100,000 population aged 15-64
		Adequate access to quality health care	Number of physicians (MD/DO degree) working within the city per 100,000 population
			Maternal mortality rate per 100,000 live births
			Premature (before age of 70) NCD mortality rate per 100,000 population
			Number of mental health practitioners per 100,000 population
		Emergency medical care	Hospital beds per 100,000 people
			Percentage of hospitals that have carried out disaster preparedness drills in the last year
		Effective emergency response services	Number of paramedics per 100,000 population
			Number of fire-fighters per 100,000 population
			Number of (operational) police officers per 100,000 population
			Number of search and rescue trained emergency responders with collapsed structures expertise per 100,000 population
			Number of reviews of city-wide emergency protocols undertaken in the past 5 years

Economy and society	Collective identity and mutual support	Local community support	Percentage children living outside of the care of a responsible adult
			Family benefits public spending as a percentage of total city GDP
			Percentage of people who responded that they know the names of their immediate neighbours
		Cohesive communities	Hate crimes reported per 100,000 population
			Women as a percentage of total elected to city-level office
			Youth unemployment rate (percentage of youth labour force)
		Strong city-wide identity and culture	Percentage of respondents who felt a sense of pride in their neighbourhood
			Number of months throughout the year that have a major, free public festival
		Actively engaged citizens	Voter participation in last municipal election (as a percentage of eligible voters)
			Proportion of corporate charitable giving within community as a percentage of city GDP
			Number of charities operating in the city per 100,000 population
	Comprehensive security and law	Effective systems to deter crime	Homicides per 100,000, per year
			Percentage re-offending by youths leaving custody
			Percentage of women and men who report feeling safe walking alone at night in the city or area where they live
		Proactive corruption and prevention	Percentage of local major local government contracts and tenders (of more than $15,500) made public
			Proportion of city residents that agree corruption is somewhat or very common
		Competent policing	Homicide arrest rate: The number of persons arrested for intentional homicide in a given year divided by the number of reported intentional homicides in the same year, x 100 and expressed as a percentage
			Percentage of the police force which has undertaken disaster response training in the last 5 years
		Accessible criminal and civil justice	Percentage difference of criminal or civil punishments imposed by judges for the same type of crime from a total average compared to the defendant's or victim's race, for the two biggest ethnic groups
			Percentage of people taken into police custody who have the option of a lawyer made available to them before questioning
			Weeks between a small claims case (less than £10,000 / $15,500) being submitted to court and

			hearing (expressed in weeks)
	Sustainable economy	Well-managed public finances	Own-source revenue as a percentage of total revenues
			Debt service ratio: total long-term debt servicing costs including lease payments, temporary financing and other debt charges divided by total own source revenue and expressed as a percentage
			Emergency planning budget as a percentage of total city budget
		Comprehensive business continuity planning	Number of years since city economic asset assessment (public and private)
			Percentage of large businesses (500+ employees) within the city that have developed business continuity plans in accordance with ISO 22301
			Percentage of registered SMEs the city has engaged with regarding business continuity in the last 5 years
		Diverse economic base	Percentage employment per sector by broad industry group
			Average GDP per capita percentage change over last 5 years
			GDP (PPP,$) per capita
			Percentage of total medium and large businesses (250 employees +) within the city that are a member of the chamber of commerce
		Attractive business environment	Average FDI (foreign direct investment)-attributable jobs over the last 3 years per 100,000 16-64 year olds
			Number of businesses per 100,000 16-64 year olds
			Percentage of adults with higher education as a percentage of total population aged 16-64
		Strong integration with regional and global economies	Value of city exports as a percentage of city GDP
			Average city GDP per capita minus national average GDP per capita expressed as a percentage
Infrastructure and ecosystems	Reduced exposure and fragility	Comprehensive hazard and exposure mapping	Percentage of city area for which a comprehensive exposure and vulnerability assessment has been undertaken within the past 5 years
			Years since the city's climate change strategic plan was updated
		Appropriate codes, standards and enforcement	Estimated percentage of new buildings completed within the city in the last 5 years that conform to current building codes and standards
			Percentage of buildings within the city with planning permission records
			Number of years since oldest current building code was reviewed
		Effectively managed	Percentage of natural areas within the city that have undergone ecological evaluation for their

		protective ecosystems	protective services
			Percentage green, open space increase or decrease over the past 5 years
			Percentage of city area that has been officially recognised for environmental protection (including shorelines down to low-tide mark)
		Robust protective infrastructure	Number of years since the last city-wide review of the adequacy of the city's protective infrastructure assets
			Number of years the city's stormwater (or other protective) infrastructure has been inspected
			Percentage of annual budget for stormwater infrastructure spent on upgrades
	Effective provision of critical services	Effective stewardship of ecosystems	Number of years since assessment of the city's ecosystem assets / services
			PM10 concentration (µg/m3)
			Percentage change in the number of native species
		Flexible infrastructure	How many years ahead does the city's electricity plan look
			Number of different supply sources providing at least 5 percent of electricity generation capacity
			How many years ahead does the city's water plan look
			Number of different supply sources providing at least 5 percent of water supply capacity
			Average $ per $10,000 of total annual expenditure of city sanitation provider(s) spent on strategic, long-term (10 years +) planning activities
			Percentage of annual unsound waste disposal (as a percentage of total disposal
			Number of different solid waste treatment or disposal plants processing at least 5 percent solid waste generated within the city (Number of sources)
		Retained spare capacity	De-rated capacity margin: the amount of excess electricity supply above peak demand (expressed as a percentage)
			Average annual residential electrical use in kw hours per year per capita
			City electricity supply capacity as a percentage of total demand
			Total water consumption per capita (litres/day)
			Percentage of the city’s wastewater that has received no treatment
			Percentage of the city population with regular solid waste collection
			Waste generation rate per capita (municipal solid waste, kg per capita per year)
		Diligent	Average length of electrical interruptions (hours

		maintenance and continuity	per year per customer)
			Average annual hours of water service interruptions per household
			Annual percentage of wastewater system losses (due to storms or malfunction) prior to treatment and/or discharge to the environment
			Percentage of defined medium- to long-term waste management service contracts agreements (as a percentage of total waste service contracts)
		Adequate continuity for critical assets and services	Number of years since last citywide critical asset assessment
			Percentage of city's hospitals with back-up electricity generators
			Percentage of city's hospitals with back-up water supply to meet its needs for three days
	Reliable mobility and communications	Diverse and affordable transport networks	Average speed of road journeys from city centre to the city boundary (km per hour)
			Percentage of commuters using a travel mode other than a personal vehicle (as a percentage of total commuters)
			Percentage of journeys undertaken by walking or cycling
			Number of other cities to which this city has daily connections by bus
		Effective transport operation and maintenance	Average percentage of the city's transport budget spent on maintenance and upgrade over the past 5 years
			Transportation fatalities per 100 000 population
			Number of years since the city evacuation plan was updated
		Reliable communications technology	Internet users (per 100 people)
			Number of media types used to alert people in an emergency
			Percentage of emergency responders with arrangements which enable them to communicate in an emergency
		Secure technology networks	Percentage of city government data with secure back-up remote storage
			Percentage of government databases protected by a dynamic proactive I.T. security system
			Percentage of infrastructure which relies on operational technology protected by a dynamic proactive I.T. security system
Leadership and strategy	Effective leadership and management	Appropriate government decision making	Number of training and knowledge sharing agreements with international networks
			Percentage of non-sensitive city government documentation and data sets that are publically available
		Effective co-ordination with	Percentage of major policy / regulatory decisions made within the last year that were the product of

		other government bodies	city-upwards, downwards (regional, national) government consultation
			Percentage of major policy / regulatory decisions made within the last year that were that are the product of cross-departmental government consultation
		Proactive multi-stakeholder collaboration	Percentage of major projects within the last year which included private sector consultation
			Percentage of city government major policy and plan changes within the past year sent out to public consultation
		Comprehensive hazard monitoring and risk assessment	Number of years since city hazard maps have been updated
			Percentage of local severe weather warnings issued by national metrological agency which are received in a timely fashion by city emergency responders
			The number of times the 5 most significant hazards identified in the city's local risk profile have been assessed by multi-stakeholders in the last 5 years
		Comprehensive government emergency management	Percentage of government departments that have tested their own continuity arrangements in the last 2 years
			Number of times the city's multi-stakeholder emergency management strategy has been tested in the last 5 year
			The number of times the 5 most significant hazards identified in the city's local risk profile have been exercised in the last 5 years. (Add up total and divide by 5)
			Number of times multi-stakeholder emergency responders meet and undertake joint activities (e.g. exercises, risk assessment, plan reviews) per year
			Number of times the emergency response centre capability has been tested (and successfully passed) in the last 5 years (for real or scenario)
	Empowered stakeholders	Adequate education for all	Percentage primary education completion rates
			Adult literacy rate (as a percentage)
		Widespread community awareness and preparedness	Percentage of households that have a smoke alarm
			Percentage of population that have made a household or a community resilience plan
			Percentage of citizens intended to be evacuated, which were successfully evacuated in the last disaster drill or disaster event in the last 5 years
		Effective mechanism for communities to	Percentage of major city plans published in the last year that incorporate consultation with communities

		engage with government	
	Integrated development planning	Comprehensive city monitoring and data management	Percentage of census data available for planning
			Number of years validity of population projections
			Percentage of residential dwellings within the city that are situated within high risk areas
		Consultative planning process	Percentage of current land use and zoning plans that have been subject to a formal consultation process
			Percentage of current land use and zoning plans that have been subject to a formal consultation process with utility providers and transport agencies
			Percentage of current land use and zoning plans that have been subject to a formal consultation process with minority communities affected by the development
		Appropriate land use and zoning	Areal size of informal settlements as a percentage of city are
			Percentage of high risk areas within the city where development is restricted or prohibited under planning guidelines
			Amount spent on transport in the last 5 years as percentage of overall city budget
			Number of years since the city plan was updated
		Robust planning approval process	Percentage of buildings [or new development] constructed within the city in the past 10 years that were approved or otherwise authorised by the relevant city planning authorities
			Percentage of planning applications submitted to the city during the past 5 years on which emergency services agencies have been consulted

Table A2. Resilience Maturity Model - Indicators

Dimensions	**Subdimensions**	**Indicators**
Leadership and Governance (L)	Municipality, cross-sectorial and multi-governance collaboration (L1)	Number of cooperation agreements with CITY stakeholders (L1M2)
		Resources dedicated to the development of the resilience action plan (L1S1, L1S2, L1M1, L1M3, L1M4)
		Number of cooperation agreements with external governmental bodies and cities (L1M2, L1A1, L1A2, L1R1, L1T1)
		Number of stakeholder group involved in resilience-building activities about resilience (L1M1, L1A2)
		Number of policies aligned with regional, national and international input (L1M2, L1A1, L1R1, L1T2)
	Legislation development and refinement (L2)	Number of cooperation agreements with external governmental bodies and cities (L2M1)
		Number of certifications (L2A1, L2R1, L2T1)
	Learning culture (learning and	Effort taken to learn from what other stakeholders do to increase resilience (L3M2, L3A1, L3R1, L3T1, L3T2)

	dissemination) (L3)	Number of cooperation agreements with external governmental bodies and cities (L3T2)
		Percentage of local government budget spent on resilience building activities (L3S1, L3M1)
		Number of debriefing meetings carried out (L3A1, L3T1, L3T2)
		Learning activities executed among stakeholders and with other cities (L3M2, L3T2)
		Percentage of lessons learned implemented per lessons learned identified (L3A1, L3R1, L3T1)
		Number of best practices shared among stakeholders (L3A1, L3R1, L3T1, L3T2)
	Resilience action plan development (L4)	Resources dedicated to the development of the resilience action plan (L4S1, L4M1, L4A1, L4R1)
		Number of cooperation agreements with external governmental bodies and cities (L4T1)
		Number of updates of the resilience action plan (L4R1)
Preparedness (P)	Diagnosis and Assessment (P1)	Number of analysis of CIs interdependencies (P1M1)
		Number of assessments to identify weaknesses (P1S1)
		Number of revisions of CI risk assessment (PIS2, P1A1, P1R1)
		Number of policies aligned with regional, national and international input (P1T1)
		Percentage of businesses/CIs with contingency plans (P1S3)
	Education and Training (P2)	Resources deployed for training exercises (P2S1, P2M1, P2A1, P2A2, P2A4, P2R2, P2T1, P2T2, P2T3)
		Number of cooperation agreements with external governmental bodies and cities (P2A2, P2R2, P2T1, P2T2)
		Number of cooperation agreements with CITY stakeholders (P2S1, P2M1, P2A3, P2R1)
		Number of awareness raising events targeting CITY stakeholders (P2S2, P2S3, P2A3)
		Frequency of training exercises (P2S1, P2M1, P2A1, P2A2, P2R2, P2T1, P2T2, P2T3)
		Number of trained volunteers (P2S2, P2R1, P2T3)
		Effectiveness of training exercises (P2S1, P2S3, P2M1, P2A1, P2A2, P2A4, P2R2, P2T2)
Infrastructure and resources (I)	Reliability of Critical Infrastructures (Cis) and their interdependences (I1)	Resources allocated to adopt extraordinary infrastructures to face shocks (I1S3, I1A1, I1T1)
		Resources allocated to improve the reliability of the CI (I1S2, I1M3)
		Number of stress tests/audits (I1M5)
		Resources invested in preventive maintenance activities (I1M2)
		Number of cooperation agreements with CITY stakeholders (I1S1)
		Number of revisions of CIs risk assessment (I1M4)
		Number of analysis of CIs interdependencies (I1M1, I1R1)
		Number of maintenance procedures in each CI sector (I1M2)
		Number of redundant systems-infrastructures per CI sector (I1M3)
		Percentage of CIs that fulfil legal requirements (I1M5)
		Average time for CIs to return to normality (I1M3)
	Resources to build up resilience and to response (I2)	Resources dedicated to the development of the resilience action plan (I2M1)
		Resources allocated to incentivize CITY stakeholders to invest in

		resilience (I2M2, I2A1, I2A3, I2A4, I2R1, I2T2)
		Percentage of local government budget spent on resilience building activities (I2S2, I2S3, I2A2, I2R2)
		Percentage of resources dedicated to lead EU projects or other join initiatives (I2T1)
		Percentage of infrastructures and population with insurances (I2A1, I2A3, I2A4, I2R1, I2T2)
		Funding received from EU projects and similar initiatives (I2S1)
Cooperation (C)	Development of partnerships with city stakeholders (C1)	Number of cooperation agreements with CITY stakeholders (C1S1, C1M1, C1A1, C1A2, C1T1)
		Number of debriefing meetings carried out (C1R2, C1T2)
		Number of mechanisms (platforms, websites) to share lessons learned with CITY stakeholders (C1S2, C1M2, C1A4)
		Number of awareness raising events targeting CITY stakeholders (C1A3, C1R2)
		Number of stakeholder group involved in resilience-building activities about resilience (C1A2, C1R1, C1T2)
		Number of best practices shared among stakeholders (C1M2, C1A3, C1R2, C1T2)
		Existence of emergency plans that integrate stakeholders (C1S1, C1M1)
	Involvement in resilience networks of cities (C2)	Number of cooperation agreements with external governmental bodies and cities (C2M1, C2A1, C2A2, C2R1, C2T1, C2T2)
		Number of mechanisms (platforms, websites) to share lessons learned with CITY stakeholders (C2T2)
		Number of policies aligned with regional, national and international input (C2T1, C2T2)

Table A3. Sendai Framework - Indicators

Sendai – Global Target	**Indicators**
A: Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality between 2020-2030 compared with 2005-2015	A-1 Number of deaths and missing persons attributed to disasters, per 100,000 population
	A-2 Number of deaths attributed to disasters, per 100,000 population
	A-3 Number of missing persons attributed to disasters, per 100,000 population
B: Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020-2030 compared with 2005-2015	B-1 Number of directly affected people attributed to disasters, per 100,000 population
	B-2 Number of injured or ill people attributed to disasters, per 100,000 population
	B-3 Number of people whose damaged dwellings were attributed to disasters
	B-4 Number of people whose destroyed dwellings were attributed to disasters
	B-5 Number of people whose livelihoods were disrupted or destroyed, attributed to disasters
C: Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030	C-1 Direct economic loss attributed to disasters in relation to global gross domestic product
	C-2 Direct agricultural loss attributed to disasters

	C-3 Direct economic loss to all other damaged or destroyed productive assets attributed to disasters
	C-4 Direct economic loss in the housing sector attributed to disasters
	C-5 Direct economic loss resulting from damaged or destroyed critical infrastructure attributed to disasters
	C-6 Direct economic loss to cultural heritage damaged or destroyed attributed to disasters
D: Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030	D-1 Damage to critical infrastructure attributed to disasters
	D-2 Number of destroyed or damaged health facilities attributed to disasters
	D-3 Number of destroyed or damaged educational facilities attributed to disasters
	D-4 Number of other destroyed or damaged critical infrastructure units and facilities attributed to disasters
	D-5 Number of disruptions to basic services attributed to disasters
	D-6 Number of disruptions to educational services attributed to disasters
	D-7 Number of disruptions to health services attributed to disasters
	D-8 Number of disruptions to other basic services attributed to disasters
E: Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020	E-1 Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030
	E-2 Percentage of local governments that adopt and implement local disaster risk reduction strategies in line with national strategies
F: Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030	F-1 Total official international support, (official development assistance (ODA) plus other official flows), for national disaster risk reduction actions
	F-2 Total official international support (ODA plus other official flows) for national disaster risk reduction actions provided by multilateral agencies
	F-3 Total official international support (ODA plus other official flows) for national disaster risk reduction actions provided bilaterally
	F-4 Total official international support (ODA plus other official flows) for the transfer and exchange of disaster risk reduction-related technology
	F-5 Number of international, regional and bilateral programmes and initiatives for the transfer and exchange of science, technology and innovation in disaster risk reduction for developing countries
	F-6 Total official international support (ODA plus other official flows) for disaster risk reduction capacity-building
	F-7 Number of international, regional and bilateral programmes and initiatives for disaster risk reduction-related capacity-building in developing countries
	F-8 Number of developing countries supported by international,

	regional and bilateral initiatives to strengthen their disaster risk reduction-related statistical capacity
G. Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030.	G-1 Number of countries that have multi-hazard early warning systems
	G-2 Number of countries that have multi-hazard monitoring and forecasting systems
	G-3 Number of people per 100,000 that are covered by early warning information through local governments or through national dissemination mechanisms
	G-4 Percentage of local governments having a plan to act on early warnings
	G-5 Number of countries that have accessible, understandable, usable and relevant disaster risk information and assessment available to the people at the national and local levels
	G-6 Percentage of population exposed to or at risk from disasters protected through pre-emptive evacuation following early warning

Table A4. Italia SDGs City Index

Italia SDGs City Index - target	**Indicators**
Goal 1. End poverty in all its forms everywhere	Economic suffering index
	Individuals in households with low-work intensity
Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Obesity and severe obesity
	Urban gardens
Goal 3. Ensure healthy lives and promote well-being for all at all ages	Life expectancy at birth
	Life expectancy at 65 years
	Infant mortality rate
	Deaths from suicide and intentional self-injury
	Deaths and injuries in road traffic injuries
Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Alphabetical competence level of the students
	Numerical competence level of the students
	Population with Isced 3 Middle School License
	Index of take charge by users of childcare
	Child education services
	Schools with ramp
Goal 5. Achieve gender equality and empower all women and girls	Education level women
	Women enrolled in university courses
	Difference between female and male employment
Goal 6. Ensure availability and sustainable management of water and sanitation for all	Resident population served by urban waste water sewerage system
	Resident population connected to urban waste water treatment plants
	Total water losses
Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all	Photovoltaic solar panels per square km
	Photovoltaic solar panels per inhabitant
Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Average taxable income per capita
	NEET 15-29 years old
	Early exit from the education and training system

Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Mobility offer public transport
Goal 10. Reduce inequality within and among countries	Gini index including imputed rents
	Digital divide from fixed and mobile network
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable	Persons residing in dwellings without cabinets
	Cycle paths
	Noise pollution
	Dead, missing and people directly affected by disasters
	PM2,5
	PM10
	Nitrogen dioxide - NO2
Goal 12. Ensure sustainable consumption and production patterns	Separate collection
	Municipal waste production
Goal 13. Take urgent action to combat climate change and its impacts	Population exposed to flood risk
	CO2
Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	Green urban usable
	Ecolabel licenses
Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Political electoral participation 2018
	Average stock of ordinary civil proceedings of first instance
Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development	Social cooperatives
	Broadband access

Table A5. Equitable and Sustainable Territorial well-being (BESdT)- Indicators

BESdT - dimension	**BESdT - indicator**
Health	Life expectancy at birth
	Avoidable mortality (age 0-74)
	Infant mortality rate
	Road accidents mortality rate (15-34 years old)
	Age-standardised cancer mortality rate (20-64 years old)
	Age-standardised mortality rate for dementia and nervous system diseases (65 years and over)
Education and training	Children who benefited of early childhood services
	Participation in the school system of children aged 4-5
	People with at least upper secondary education level (25-64 years old)
	People having completed tertiary education (ISCED 5, 6, 7 or 8)
	First-time entry rate to university by cohort of upper secondary graduates
	People not in education, employment, or training (NEET)
	Participation in life-long learning
	Inadequate level of numeracy (students in grade 8)
	Inadequate level of literacy (students in grade 8)
Work and life balance	Employment rate (20-64 years old)
	Non-participation rate

	Incidence rate of fatal occupational injuries or injuries leading to permanent disability
	Youth's employment rate (15-29 years old)
	Youth's non-participation rate
	Paid days in the year (employees)
Economic wellbeing	Average disposable income per capita
	Average annual salary of employees
	Average annual per capita amount of pension income
	Pensioners with a low pension income
	Per capita assets
	Bad loan entry rate of bank loans to households
Social relationships	Non-profit organizations
	Schools without physical and structural barriers
Politics and institutions	Voter turnout
	Voter turnout (Regional Councils)
	Women municipal councillors
	Municipal councillors under the age of 40
	Prison density
	Municipalities collection capacity
	Provincial governments and Metropolitan Cities collection capacity
Safety	Intentional homicide rate
	Deadly crimes reported
	Burglaries reported
	Pick-pocketing reported
	Robberies reported
	Road mortality in non-urban roads
Landscape and cultural heritage	Density and importance of museums' heritage
	Spread of rural tourism facilities
	Presence of Historic Parks/Gardens and other Urban Parks recognised of significant public interest
Environment	PM10 Annual average concentration
	PM2.5 Annual average concentration
	Warm Spell Duration Index
	Extreme precipitation events
	Consecutive Dry Days
	Population at risk of landslides
	Population at risk of flood
	Water losses in urban supply system
	Protected natural areas
	Urban green
	Municipal waste generated
	Separate collection of municipal waste
	Electricity from renewable sources
Innovation, research and creativity	Patent propensity
	Municipalities with online services for families
	Brain circulation (Italians, 25-39 years old)
	Employed in local units of cultural enterprises
Quality of services	Irregularities in electric power distribution
	Seat-Km of public transport networks

	Overall Fixed Very High-Capacity Network (VHCN) coverage
	Separate collection service for municipal waste
	Hospital beds in high-care wards
	Hospital patient emigration to a different region
	Medical specialists
	Inpatient and day care hospital beds in public and private accredited hospitals per 10,000 inhabitants

Made in Italy and Craftsmanship: The Transition to Sustainability

Simona Arduini*

Department of Business Studies
University of Roma Tre
Via Silvio D'Amico, 77 - 00144 Rome - Italy

Tommaso Beck

Department of Business Studies
University of Roma Tre
Via Silvio D'Amico, 77 - 00144 Rome - Italy

* *Corresponding author*

Abstract

Made in Italy, in its entrepreneurship, constitutes an invaluable cultural and economic heritage for our country and too is worldwide considered as a synonym of art, quality, uniqueness and craftsmanship. In fact, this sector contrasts "knowing how to do well" against mass production, often poor of quality in materials and finishes, as well as certainly lacking an artistic and innovative dimension.
The analysis of the literature highlights that the craftsmanship dimension, in fact, imposes flexibility and adaptability to particular needs, according to a slower pace of production, as well as shorter production lines at the local level, also making use of local craft, skills and traditions, fitting them into regional and national culture and heritage (Murzyn-Kupisz & Hołuj, 2021). In order to avoid making our analysis generic and too vague, it is important to specify that our theoretical background will refer to a specific type of company, i.e. craftsmanship.
Our research objective, in the context just described, will be to observe how these realities are moving towards the rapidly expanding race for sustainability, not only as a new sales opportunity, but also, as a necessary condition to guarantee their survival over time. The call to sustainability, especially at the European level with the transposition of the new European Directive 2022/2464/EU approved in November 2022, will lead to an obligation of sustainable reporting to a larger group of companies (Ottenstein et al., 2021). Made in Italy, typically made up of SMEs, will therefore certainly be directly affected by this new scenario, for which it will be appropriate to take the right measures and understand the new logic.

In addition to the above, based on an empirical analysis carried out on a sample of companies referring to the blown glass sector, we have analyzed quantitative data in order to bring evidence to our study. The blown glass sector, in fact, corresponds to Italian excellence of craftsmanship, and also, to fine art (Bialek, 2022). In this sector, it is also true, that there is evidence of numerous polluting residues, making the issue of sustainability very relevant and crucial (Hamada et al., 2022). Our empirical research, thanks to the data provided by the association "AssoVetro," the National Association of Glass Industrialists adherent to "Confindustria", will therefore propose to analyze how in a group of sample companies sustainability is managed, valued and reported. In accordance with what has been stated, the purpose of our empirical analysis is to answer the question: "How the glass sector has grown in relation to the impact of sustainability?".

Keywords – Sustainability, Entrepreneurship, Made in Italy, Craftsmanship, SMEs, Blown Glass Sector

Paper type - Academic Research Paper

1 Introduction

Thanks to human ability and inspiration, made possible by craftsmanship, the value of a product can increase in terms of quality and uniqueness compared to a non-standardized good (Campana et al., 2016). In modern times, in line with Campana et al. (2016) said, we are witnessing a gradual and steady enhancement of craftsmanship, not only connected with the elaboration of the finished product, but especially, in the process that influences the performance of "artisan" workers, characterized by expertise, creativity, culture, history, tradition and attention to the territory. Not far from the characteristics listed above for producers, we can also find factors related to individual consumer elements. According to Rivaroli et al. (2020), these can be configured in the following list: information and knowledge seeking, local identity, self-identity, humanization and brand personification, and also price perception. Certainly, it is clear that what was previously stated is strongly in contrast with the production logic, followed by the industrial revolution, where the keywords were: speed, standardization and decreasing costs. In this context, industry mainly employed workers to control machines that increase the efficiency of production by replacing humans in repetitive tasks instead of artisan work.

In his famous book Richard Sennett (1998) believes, to avoid being nostalgic for the past, that we need to rediscover the best craftsmanship and produce higher quality products, valuing artisans' autonomy, dialogue with customers and

social responsibility. In our opinion, what Sennett stated twenty-five years ago, today is very relevant and valid at the Italian and international level. The attention that the world is showing on sustainability, in fact, is pushing towards the choice of products that are far from the typical logic of mass production, bringing a regression effect with respect to the logic of "mass-produced" items. It therefore seems fair to say, as we will try to demonstrate in the course of the paper, that craftsmanship and sustainability are two closely related concepts. Some sectors, such as blown glass, certainly constitute a clear and concrete example of this trend.

The challenge of sustainability, however, must therefore be seen on the one hand as a great potential, but at the same time, also as a significant change in today's practice, thus constituting a considerable effort and commitment for companies (Überbacher et al., 2020). In these times, Italy is experiencing a major challenge in transitioning technology to a level where it can get closer to the needs of the customer and to expand the scope of SMEs as well (Matarazzo et al., 2021). This effort could be in our opinion an element strictly connected to having a better vision, and better practice, in supporting and implementing sustainability respecting our craftsmanship dimension.

2 Craftsmanship and Sustainability

The "creative economy", which is growing at the global level, is increasing requires skills typical of craftsmanship, in a trend toward a growing consumer culture that emphasizes authenticity and quality products (Klamer, 2012). As reported by Klamer (2012), Italy provides interesting examples of how associations and institutions responsible for craftsmanship can play an important role in boosting this kind of production. In our opinion, a successful example of what has been stated, turns out to be the blown glass sector, because of his attention and respect for sustainability shown since the 18th century.

In the 18th century, conditions were created for the development of a "glass culture" in and around Venice, as well as for the emergence of real entrepreneurs in the glass industry and the emergence of highly specialized production areas (Panciera, 2006). According to Panciera (2006), the glass production network revolved around blown and semi-finished glass from the island of Murano, and the existence of a series of vertically integrated and aligned activities led to a hierarchy of specialization, and also a real industrial culture in the city, that

preserved valuable knowledge that still exists today. The number of workers in the Murano furnaces, which numbered more than 40 at the end of the 18th century, increased significantly, especially among those who produced glass sheets and blown glass. The number of glass workers in Murano increased from about 160 at the end of the 17th century to 284 in 1787. The total number of furnace workers was between 5 and 6,000, accounting for about 40 percent of the island's working male population (Panciera, 2006).

Today glass is, worldwide, one of the most important materials that plays an important role in both traditional and innovative sectors (Testa et al., 2017). In the innovative sector, glass is used in combination with certain substances for high-tech applications such as space exploration, medical research, optics, and telecommunications. As reported by Testa et al. (2017), the main glass traditional sectors are instead, container glass (which include a range of products used for packaging food, beverages, cosmetics and pharmaceuticals), flat glass (which includes products used in construction, transportation, and solar energy) and continuous fiberglass and glass wool, which are used for insulation, roofing and composite reinforcement.

In Italy, as in the rest of the world, this type of production belongs to large companies that are often part of important international groups that operate according to a mass logic production. On the opposite, the landscape of blown glass maintains to this day an artisanal and artistic connotation, living in small realities composed of artisans and SMEs. This will mean, in the immediate future for this sector, a delicate obligatory adaptation in line with national and European laws, related to sustainability that previously referred exclusively to larger realities that are part of the same sector.

The challenge of sustainability today is an issue that directly affects not only large companies anymore, but also medium-sized and small ones (Martins et al., 2022). Indeed, the new 2022 CSRD directive, which is a continuation of the European Green Deal, aims to greatly expand sustainable reporting requirements for more companies, as well as to improve the quality of the data required. At the plenary session on November 28, 2022, members of the European Parliament adopted the CSRD directive with 525 votes in favor, 60 against, and 28 abstentions. After the European Parliament's position was approved by the Council, the legislative act was adopted. In addition, the new rules are to be implemented by member states within the next 18 months, introducing more detailed reporting requirements on sustainability issues, environmental rights,

social rights, human rights and governance factors. Adoption of this law will bring the number of companies involved from the current 11,600 to 49,000 by 2028, according to a proportionate, cascading involvement plan aimed at encompassing as many players as possible with an effective, efficient reporting system that has the will to overcome a cultural gap in the expression of new needs and potential. The rules will be implemented between 2024 and 2028 and will affect, in a cascade logic, firstly "large enterprises" not yet subject to the Non-Financial Reporting Directive, and subsequently, SMEs and the residual listed companies (Article 5, p. 80 – EU Parliament, 2022).

The sustainable revolution, in fact, can only pass through a cultural revolution that, by leveraging the expectations of the younger generations, leads to a general increase in environmental, social awareness and knowledge sharing system (Arsawan et al., 2022). The call to sustainability, according to the terms of the CSRD just mentioned, will affect smaller realities for the first time, which will have to react with scarcer tools at their disposal (Dinh et al., 2022).

3 Empirical Analysis

3.1 Methodological approach

In our opinion, the blown glass sector is in our opinion a congenial case study to represent the state of the art, in the current moment, of the transition to sustainability of SMEs in the context of Made in Italy. Indeed, on the one hand, this sector has been known for more than two centuries for its artistic connotation, but at the same time, also for its significant environmental impact in terms of waste and pollution. In line with the presented framework, our research methodology was focused on the analysis of the sector presented thanks to the valuable sustainability report made "AssoVetro" through "Confindustria". Specifically, from the analysis of the aforementioned sustainability report, our attention was focused on observing a few main variables, such as:

- Research And Development Expenses;
- Turnover Growth;
- Quality Certifications (OHSAS 18001: 2007 ISO 22000: 2018 ISO 14001: 2015 ISO 9001: 2015);
- Environmental Certifications;
- Injuries.

The variables listed were analyzed in the only two sustainability reports provided by "AssoVetro," namely 2016-2018 and 2019-2020.

3.2 Sample

The sample examined, in the reports provided by "AssoVetro" at this date, concerns a group of 19 companies taken into account, respectively: 15 hollow glass manufacturers and 4 flat glass manufacturers. The premise, about the composition of the sample, is crucial because it constitutes the main limitation of this empirical research. In fact, the entities assimilated to the size of the blown glass sector are connected exclusively to the 15 hollow glass manufacturing companies. In concrete terms, although these makeup as much as 78.95% of the sample analyzed by "AssoVetro," the data analyzed in this empirical analysis has not been purified of the remaining 21.05%, i.e., from the 4 flat glass manufacturing companies not connected to the blown glass sector. Talking about small companies, it was impossible to find reliable data purified and referring only to the sample of our interest, forcing us to a scientific compromise. A next step of this research, could be in fact, to find the strategic sustainability information, summarized in the aforementioned list, by implementing an ad hoc interview for each reality, thus increasing the percentage of reliability of the data.

3.3 Collected data

From the reports provided by "AssoVetro," 2016-2018 and 2019-2020 respectively, it was possible to collect the data inherent to our field of interest classified into the five categories shown in Figure 1. By our choice, we decided to weight the number of injuries through the ratio of two variables, namely the frequency index and the severity index, both of which are present in the sustainability reports. The table pictured in Figure 1 also shows the totality of data from all sample companies, collected in the reports for each individual year of the reporting period:

- 2016 to 2018: sample composed of 16 companies;
- 2019 to 2020: sample consisting of 19 companies;

	Sustainability Report 1			Sustainability Report 2	
	2016	2017	2018	2019	2020
Research And Development Expenses	22.480.462,00 €	24.238.303,00 €	26.182.869,00 €	15.970.506,00 €	13.945.782,00 €
Turnover Growth	2.391.784.195,00 €	2.452.781.838,00 €	2.830.507.688,00 €	3.141.871.260,00 €	2.991.866.891,00 €
Quality Certifications	10	11	11	9	11
Environmental Certifications	61	69	79	91	95
Injuries*	10,84	6,974	5,194	6,896	5,2212
*Frequency index x Severity index					

Figure 1

Because of the presence of this significant difference in sample composition between Sustainability Report 1 and Sustainability Report 2, in order to standardize the data collected, we decided to divide the individual data for the companies in the sample year by year. Figure 2, in fact, corresponds to the overview of the average data and performance collected in order to arrive at our statistical conclusions with reference to a model company.

	Sustainability Report 1			Sustainability Report 2	
	2016	2017	2018	2019	2020
Research And Development Expenses	1.405.028,88 €	1.514.893,94 €	1.454.603,83 €	840.552,95 €	733.988,53 €
Turnover Growth	149.486.512,19 €	153.298.864,88 €	157.250.427,11 €	165.361.645,26 €	157.466.678,47 €
Quality Certifications	0,625	0,6875	0,611111111	0,473684211	0,578947368
Environmental Certifications	3,8125	4,3125	4,388888889	4,789473684	5
Injuries*	0,68	0,435875	0,288555556	0,362947368	0,2748
*Frequency index x Severity index					

Figure 2

Subsequent to the composition of our sample, as explained in the logical step of the previous paragraphs, we compared the data collected in Figure 2 in two-year classes, highlighting in addition, the decreases by highlighting the relevant cells by coloring them. The composition of Figure 3, therefore, corresponds to a statistical comparison of the data in Figure 2 for each individual class of year x and year x+1 starting with the first year available from the sustainability reports of "AssoVetro".

	2016-2017	2017-2018	2018-2019	2019-2020
Research And Development Expenses	8%	-4%	-42%	-13%
Turnover Growth	3%	3%	5%	-5%
Quality Certifications	10%	-11%	-22%	22%
Environmental Certifications	13%	2%	9%	4%
Injuries*	-36%	-34%	26%	-24%
*Frequency index x Severity index				

Figure 3

3.4 Results and Discussion

In light of the data collected, it is possible to make some reflections that can provide evidence to support our initial question: "How has the glass sector grown in relation to the impact of sustainability?". The last column of the table in Figure 3, considering this simple question, gives us the cue to draw some conclusions.

Companies' commitment to proper management of their environmental profiles is not only in compliance with environmental legislation, but is geared toward reducing associated impacts and continuously improving performance, as evidenced by the steady growth in certifications from 2016 to 2020. This logic is evidenced by the increasing adoption of management systems certified to major international standards. The theme of management system certifications covers not only the industry's environmental, energy commitments and performance, but also those related to quality, worker health and safety, with a 22% increase from 2019 to 2020.

Parallel to this, the documents analyzed showed how health and safety protection in the workplace is a top priority for companies in the glass sector, through the observation of accident dynamics as a fundamental requirement of membership. In addition to technical interventions, investments and targeted training, companies flank intensive information and awareness-raising activities for employees of immediate perception - through posters, panels and dedicated signage - which report behavioural and organizational information on prevention. Reporting by all employees of potential unsafe behaviors and situations identified within work environments is also encouraged in order to take timely and preventive action. The documents covered attest to the industry's decades-long commitment to safety, achieved through specific investments aimed at ensuring safe conditions in facilities, training employees to observe safe behaviors, appropriate protective equipment, and appropriate work organization measures. Thanks to this focus, as shown in Figure 3, the trend of accidents has always been declining, with the exception of the two-year period 2018-2019.

The trend in investment in production facilities, over the five-year period 2016-2020, was measured as an increase of plant and machinery. The significant decline recorded in the two-year period 2018-2019 and 2019-2020 can be attributed, on the one hand, to the physiological cyclicality of investments in new plant and machinery - which recorded significant peaks between 2016 and 2018 - and, on the other hand, as a reversal of trend in IT investments not detected in this class.

In the area of investments, in fact, the questionnaire survey by "AssoVetro" investigated that the improvements sustained by companies in IT - including software, licenses and, in general, investments in the digitization of production processes - are clearly growing. In addition to this, a further setback in investment is certainly due to the pandemic crisis that occurred in 2020, which has effectively halted the development of new initiatives.

If the pandemic factor, as stated, has weighed on investment we can say with certainty that it has also affected the turnover to a certain negative extent. The trend for turnover, as can be seen from Figures 3, followed a constant and linear growth until a negative contraction of -5% was recorded in the two-year period 2019-2020. This data, while negative, is nevertheless encouraging and stimulating for the future. Glass companies, in fact, benefit a constantly growing domestic and international market, thanks in part to the efficient import/export network that has allowed these companies to survive in such a complex historical moment.

What we can say, in conclusion of this empirical analysis, is that although with major limitations and elements to be deepened and improved, this empirical analysis has confirmed our initial thesis. Glass companies have always been attentive to sustainability and ethics by respecting: the environment, culture, people and territory. This is the reason that allows companies to establish themselves and grow in a competitive environment, but without sacrificing attention to sustainability and ethics.

4 Conclusions

Our thesis, in conclusion, is that craftsmanship, precisely because of their propensity for culture and respect for traditions, as well as for the surrounding environment, are certainly an example of excellence also in the pursuit of sustainability. In fact, regardless of their size and their presence on the Italian territory, these realities highlight the attention to sustainability not only as an element of pride, but on the contrary, as a real and proper condition necessary for their production and their company philosophy. Sustainability, therefore, was not a foreign concept to this type of company, which however today will be called upon to report this information, certainly having fewer resources than large companies. This is undoubtedly an excellent starting point, but at the same time, it makes us aware of the future effort that will have to be done to provide the right tools for this transition. So, in conclusion, sustainability could concern the

continuation, and preservation, of craftsmanship in terms of skill, culture and tradition in the future (Fyhn & Søraa, 2017). Indeed, in our opinion, this focus on sustainability and ethics will enable companies in the blown glass industry not only to survive the complex and difficult historical moment, but also, to project themselves into a future of growth and improvement without losing the main characteristics of their business history.

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Agri-Food Digitalization and Sustainability: A Scientometric Analysis toward Industry 5.0

Angelo Corallo

University of Salento
Department of Innovation Engineering
Complesso Ecotekne, Via per Monteroni sn, Lecce (Italy)

Maria Elena Latino*

University of Salento
Department of Innovation Engineering
Complesso Ecotekne, Via per Monteroni sn, Lecce (Italy)

Marta Menegoli

University of Salento
Department of Innovation Engineering
Complesso Ecotekne, Via per Monteroni sn, Lecce (Italy)

Fulvio Signore

University of Salento
Department of Innovation Engineering
Complesso Ecotekne, Via per Monteroni sn, Lecce (Italy)

* *Corresponding author*

Abstract

Recent environmental changes and socio-economic issues, required companies to adopt sustainability practices in order to safeguard the ecosystem on which insist and, at the same time, guarantying their profitability. In this scenario, the agri-food industry is particularly concerned, as food production and delivery have high impact on environment and society. Companies are investing in a digitization journey, surfing the flow of the transition from the actual technocentric vision of technology to a synergistic one involving social and environmental sustainability. Starting from these assumptions, the aim of this paper is to provide an overview of how the scientific literature explored the relationship between sustainability, Industry 4.0 (I4.0) and the agri-food sector, as well as delving into the role of the I4.0 pillars in driving sustainability moving toward Industry 5.0 (I5.0). A rigorous methodology guided the study toward a double-layers scientometric, performed with Bibliometrix. The sample was identified, using PRISMA methodology, in Scopus and

WoS, leading to a database of 1114 papers and a further 9 sub-datasets, one for each I4.0 pillar. These datasets were analyzed in depth in order to recognize i) the main characteristics of the investigated research field; ii) the main research routes addressed in the investigated research field; iii) the current capability of each I4.0 pillar to drive sustainability in the investigated research field. The results reveal that the topic is recently and internationally debated; there is a strong interest in searching for sustainable solutions that safeguard natural resources with the help of data-driven technologies; among the I4.0 pillars, the simulation is the most recognized pillar in driving agri-food toward sustainability; the main topics addressed are linked to environmental and social domains. The study provides research and practical implications consisting of understanding the field concepts multiplicity, laying groundwork for future researchers, encouraging in the study replication, understanding how pursue sustainability issue, supporting the adoption of technology-based sustainable practices toward I5.0, stimulating in the exploration of new sustainability topics leveraging on technology application.

Keywords – sustainable development, knowledge management, digitalization, agriculture 4.0, environmental impact

Paper type – Academic Research Paper

1 Introduction

In a world characterized by a growing need to environment respect and raw materials preserve, to enhance workplaces ethic practices and to make more efficient cost saving decision-making, companies are constantly faced with the challenge to ensure sustainability practices: economic, social or environmental (Adams, Jeanrenaud, Bessant, Denyer, & Overy, 2016). By virtue also of the regulatory references that are gradually being proposed, companies need of identifying and implementing solutions and strategies consistent with this objective, in order to satisfy a twofold need: guarantee the productivity, and innovate the products, processes and strategies to implement the desirable level of sustainability (Ajwani-Ramchandani et al., 2021; Macassa, Rashid, Rambaree, & Chowdhury, 2022). Among the main recipients of these measures, a strategic player is the agri-food industry which has a high impact on environmental and social ecosystems (Ioris, 2018). Agricultural activities are essential for food production that, by 2050, must double to fulfil the global population demand: is expected that global population will reach about 9.8 billion by 2050 and 11.2 billion by 2100 (Abbate, Centobelli, & Cerchione, 2022). This need could encourage companies to adopt strategies to maximize the production compromising the sustainable use of resources. For example, in the tropical areas

the agricultural expansion is one of the deforestation causes, with consequent loss of timber or biodiversity (Rueda, Garrett, & Lambin, 2017).

In the advanced economies, efficient model production in agriculture are based on the use of pesticides and chemicals which are capable of increasing crop yields but generate significant environmental impacts (Shuqin & Fang, 2018).

Another relevant issue, related to the society lifestyles and wellness in the advanced economies, is the increased food waste which is triggering a domino effect on sustainability and global hungry: at now approximately 33% of all foodstuffs produced globally, corresponding to 930 million tones, is leaving 800 million people hungry (Belaud, Prioux, Vialle, & Sablayrolles, 2019). These evidences attested a global agri-food industry under pressure to provide products that meet higher social and environmental standards.

Reducing the environmental impact, managing social issues, solving supply chain network design problems, tackling the economic pressure, fulfilling the informative needs expressed by conscious consumers and complying with regulations (Latino, Menegoli, Lazoi, & Corallo, 2022) represent some of the main challenges that agri-food companies must face. Companies are investing in a digitization journey to try to solve challenges of this nature (Secundo, Schena, Russo, Schiavone, & Shams, 2022). Empowered by the fourth industrial revolution (I4.0) advances, digital technologies have pervaded different industries, including agri-food industry (Hassoun, Boukid, et al., 2022). I4.0 proposes 9 technological pillars (additive manufacturing, advance robotics, augmented reality, big data analytics, cloud computing, cybersecurity, Internet of things (IoT), simulation and system integration (Narula et al., 2021)) which have been widely studied with focus on the concept of smart farms and smart food factories (Hassoun, Bekhit, et al., 2022). Therefore, in the agri-food sector, these technologies are capable of supporting the knowledge management in the agri-food supply chain (AFSC), bridging the gap between digitalization and sustainability, thus improving the performance (Ranta, Aarikka-Stenroos, & Väisänen, 2021).

Digitalization, driven by the I4.0 paradigm, conceives a societal transformation that use ubiquitous digital technologies to connect ever larger social space, without any specific attention to sustainability. Complementing the existing I4.0 paradigm, the I5.0 paradigm born. The fifth industrial revolution as the mission to transit from the actual technocentric vision of technology to a synergistic vision of technology and social and environmental sustainability. I5.0, in fact, is considered

as one of the driving forces to enrich the green transition with social and economic expectation (Saniuk, Grabowska, & Straka, 2022)

Addressing the current growing focus on I4.0 and sustainability, Abbate et al., (2022) proposed a literature review, content analysis-based, to summarize the research stream which in the last 10 years studied the impact of I4.0 on agri-food sustainability, representing, at the better knowledge of the authors, the only study focused on this specific topic. As declared by the authors, this study has several limits which probably affect the breadth and validity of the results: i) the consideration of only Web of Science (WoS) database; ii) the selection of only articles and reviews published in double-blind peer-reviewed journals; iii) the use of machine learning techniques to perform data collection and screening which are less accurate than systematic literature review procedures. Moreover, considering that the data collection phase in Abbate et al., (2022) study ended the 5th February 2021, it is partially capable of exploring how the agri-food digitalization process embraces the sustainability issues moving toward the I5.0, since this paradigm was proposed in October 2021 by Xu et al., (2021).

Whereas the exploitation of the available scientific knowledge could be useful for agri-food companies to increase the decision-making effectiveness during the implementation of technology-based sustainable practices, this research field requires more attention. For example, understanding how each I4.0 pillar can be useful in supporting sustainable development (moving toward I5.0) can be discriminating in the choice of a technology. Leveraging on these assumptions, the purpose of this paper is to explore the role of digital technologies during the implementation of sustainability practices in the agri-food industry, overcoming the limits of the previous literature review. The following research questions (RQs) were posed to achieve the study purpose:

RQ1–What are the main characteristics of the investigated research field?

RQ2–What are the main research routes addressed in the investigated research field?

RQ3–What is the current capability of each I4.0 pillar to drive sustainability in the investigated research field?

Specifically, investigating the first RQ we want to provide the updated picture of the analyzed research topic through the description of its characteristics: i) annual scientific production, ii) most frequently used journals to publish articles on the topic, iii) authors most involved (and collaboration between their countries) and iv) countries that produced the most influential contributions.

Investigating the second RQ we want to the create a frame about the main research routes addressed by scholars through the analyses of the: i) most frequently used words and, ii) most prominent thematic clusters.

Finally, investigating the third RQ we want to discover the capability of each I4.0 pillar to drive sustainability in agri-food industry analyzing the use of each pillar in food sustainability.

A rigorous methodology (Section 2) was followed to achieve the purpose of the study. Section 3 highlights the results of the double-layers scientometric, organizing them by the core topic of the RQs. Section 4 discusses the results and reflects theoretical and practical implications. Finally, Section 5 presents the conclusions, limits and follow ups of the study.

2 Materials and Methods

Starting from the proposed RQs, we need to identify bases of knowledge characterized by features useful to provide an answer to each question. Therefore, we realized a double-layers scientometric analysis in which we used search schemes to discover data samples to analyze. In both layers, we used the PRISMA guidelines (Page et al., 2021) for data collection procedure and the Bibliometrix software (Aria & Cuccurullo, 2017) for data analysis (Figure 1). Data collection was realized between December 2022 and January 2023, querying WoS and Scopus, recognized as two of the most relevant scientific databases (Mongeon & Paul-Hus, 2016). All samples were selected considering only the contributions in English language and eliminating duplicates, leading to the 10 final samples described in Figure 1.

Specifically, the first layer of scientometric analysis was designed to obtain, through a single query, a knowledge base useful to identify the main characteristics and the main research routes addressed by the investigated research field. We analyzed this sample using frequency analysis on bibliometric data to provide the updated picture of the analyzed research topic toward the description of its main characteristics (timespan, most relevant sources, production countries, most influential authors and collaboration network). Moreover, applying a quantitative text analysis on contributions' abstract, we detected the most frequent words in the sample. Finally, through a thematic cluster analysis on the abstracts in the sample we discovered the main research routes addressed by the research field.

Therefore, a second layer of scientometric analysis was designed to obtain, the current capability of each I4.0 pillar to drive sustainability in the investigated research field. Here, we used a multi-query approach, proposing 9 different sub-datasets, one for each I4.0 pillar, through which investigate the capability of each I4.0 pillar to drive sustainability.

These 9 sub-samples were analyzed through a quantitative text analysis, based on the identified contributes title and abstract. The aim was to retrive, for each sub-queries, an overview of the most frequent representative contents, thematic clusters and co-occurrences. About co-occurrences, an analysis of the most frequent binomials in the articles' abstracts was performed. Following their identification, and from the emerging ones, those representing sustainability topics for the agri-food industry were selected.

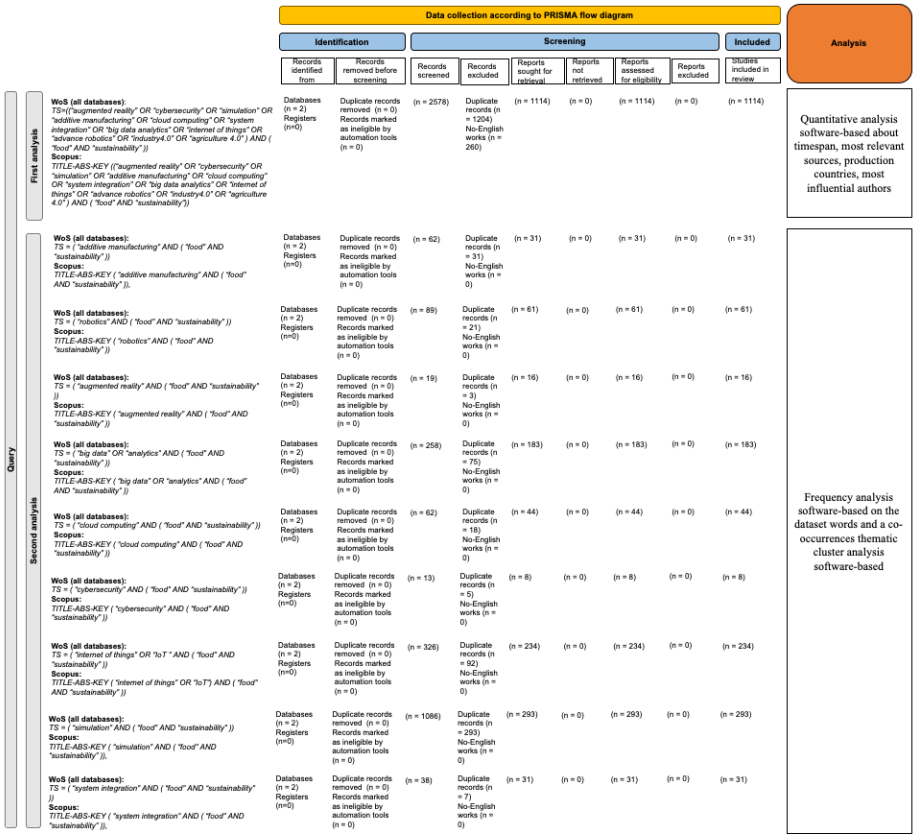


Figure 2: Procedure of data collection, according to PRISMA flow diagram, and data analysis

3 Results

This section highlights the results of the double-layers scientometric, organizing them by the core topic of the RQs.

3.1 The main characteristics of I4.0 for sustainable agri-food industry research field

In order to answer to the RQ_1: *what are the main characteristics of the investigated research field?*, we provided the updated picture of the analyzed research topic toward the description of its main characteristics, described below.

Figure 2 summarizes the annual scientific production. Our results showed that the largest surge of scientific papers on the topic occurred in the years 2020 to 2022, with 547 articles, about half the total sample. By considering the analyzed timespan (1994-2023), the average growth rate of articles is therefore around +43.2%.

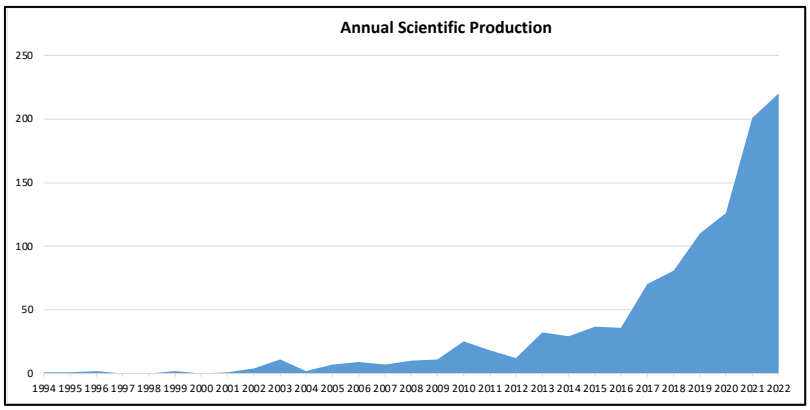


Figure 3: Annual Scientific Production

The journals most interested in the publication of studies focused to analyze the role of I4.0 in sustainability, addressed topics related to the environmental protection and sustainable solutions study to improve environmental resources management, such as Sustainability, Journal of Cleaner Production and Plos One. The aforementioned journals also prove to be those most present in the trend of recent years, with significant increases from the year 2019. Figure 3 shows the list of the most productive authors in the research field and the established collaboration network. Considering authors that published at last 4 studies, we

identified a list of 32 relevant authors guided by Liu Y. with 10 studies. Furthermore, in terms of collaboration world map, the most productive cooperation networks belonged to USA and China; France, Germany, Italy and United Kingdom (UK), as well to India and UK.

Authors	Articles
Liu Y	10
Kumar A	7
Wang X	7
Wang Y	6
Zhang J	6
Zhang L	6
Hassoun A	5
Jagtap S	5
Kang S	5
Klerkx L	5
Krejci Cc	5
Li Z	5
Liu X	5
Wang J	5
Wang Q	5
Wu W	5
Zhang X	5
Alonso Rs	4
Corallo A	4
Jambrak Ar	4
Kisekka I	4
Latino Me	4
Liu J	4
Liu L	4
Menegoli M	4
Prieto J	4
Qiu J	4
Sharma R	4
Shastri Y	4
Singh R	4
Telukdarie A	4
Wang D	4

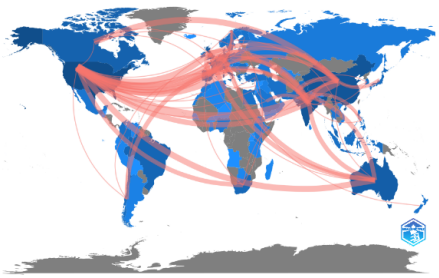
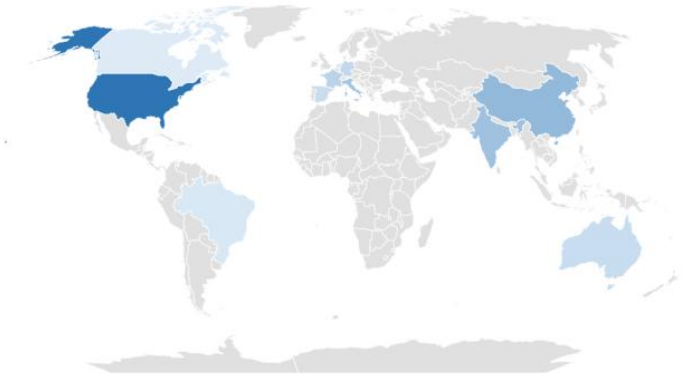


Figure 4: Most productive authors and collaboration network

Analyzing the sample from the geographical viewpoint (Figure 4) the countries more focused on the analyzed research topic are: USA (723), China (366), India (322) Italy (301), Great Britain (297), France (222), Germany (195), Australia (178), Spain (174), Netherlands (135), Brazil (119) and Canada (102).



Legend: The darker color indicates a higher frequency of publications

Figure 5: Most productive countries.

Summarizing, by answering to RQ_1, an exponential increase in interest on the subject in recent years, with a prevalence of works published in journals attentive to the issues of sustainability and the protection of the environment and natural resources, with mainly Chinese authors and with an international distribution, without any prevalence of continents, of works on the subject resulted. From an initial analysis, therefore, the topic appears to be of recent crucial importance and worldwide interest.

3.2 The main research routes addressed by I4.0 for sustainable agri-food industry studies

In order to answer to the RQ_2: *what are the main research routes addressed in the investigated research field?,* we identified the main research routes addressed by scholars.

By focusing to discover the most used words (up to a maximum frequency of 500), relevant themes emerged (Figure 5).



Figure 6: Word cloud of the most frequent words in dataset abstracts

The most frequent words were "food", "sustainability", "production" and "water", as if to define an order of priority focused on finding solutions to ensure sustainable food production capable of respecting the main environmental resources, such as water. Moreover, elements of strategic importance were highlighted, such as the desire to identify "models" and "systems" aimed at better "sustainable" "management" based on "data". Interest also turns out to be on

"environmental" and "agricultural" aspects through the use of the nine pillars, which emerged at different frequencies in the word cloud.

In terms of thematic clusters (Figure 6), the analyses revealed the preponderant presence of two clusters. The blue cluster is strongly centered on concepts related to supply chain management since it involves terms such as supply chain/s, food supply, food waste, sustainable development, sustainable food, food safety, circular economy. Moreover, a set of terms related on data analytics emerged (e.g., artificial intelligence (AI), machine learning and data analytics) testifying the use of this I4.0 pillar in the supply chain management. The red cluster is targeted on the food production impacts involving topic related to climate change, food security, food production, environmental sustainability, greenhouse gas, agricultural production and management practices. Even in this case we discovered terms related to I4.0 and specifically to the pillar of simulation (e.g., simulation model) testifying its usage in the management of food production impacts.

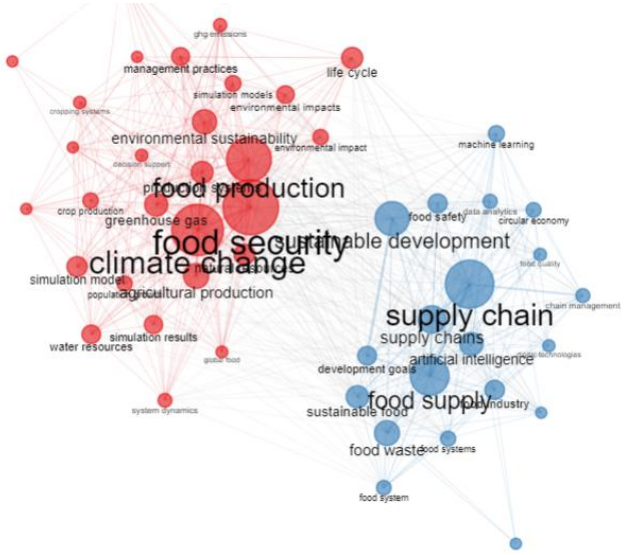


Figure 7: Main thematic clusters in the investigated research field

Summarizing, by answering to RQ_2, the main research routes followed in the ex-tant literature are related to the study of technology-based solution for environmental sustainability purposes, with particular reference to the domain of food production (within which actions and practices are revolving toward an increasing attention to save natural resources and decrease environmental

impact), and of food supply chain management (with particular attention to the assurance of food safety, security and quality).

3.3 The current capability of I4.0 pillars to drive sustainability in agri-food industry

In order to answer to the RQ_3: *What is the current capability of each I4.0 pillar to drive sustainability in the investigated research field?,* we investigated the capability of each I4.0 pillar to drive sustainability in agri-food industry. Firstly, we investigated the use of each pillar in food sustainability evaluating the size of the samples obtained by applying the 9 queries in the selected databases, as described in Section 2.

In accordance with the results coming from cluster analysis (see section 3.2), the results show that the technologies belonging to the Simulation pillar are the most used for sustainable purposes in the agri-food field, with a clear prevalence of 56.3% of the sample. This is followed by the IoT (16.6%) and Big Data (13.0%) pillars. The remaining pillars are currently marginally used: Advanced Robotics pillar (4.8%), Cloud Computing (3.1%), Additive Manufacturing (2.2%), System Integration (2.2%), Augmented Reality (1.1%), and Cybersecurity (0.6%).

Moreover, analyzing the most frequent co-occurrences in the abstracts of the 9 I4.0 pillars samples, the results showed that each pillar is related to specific sustainability topics of agri-food industry (Figure 7). Specifically, our analysis revealed that some sustainability topics recur in different pillars, for example: i) climate change is a sustainability topic that agri-food industry address using simulation, advance robotics, IoT and, big data analytics; ii) food security or safety is a sustainability topic that agri-food industry address using simulation, advance robotics, cloud computing, IoT, cloud computing, augmented reality, big data analytics and system integration; iii) food waste and waste management are sustainability topic that agri-food industry address using additive manufacturing, IoT, cloud computing and augmented reality.

Other sustainability topics seemed to be more linked to specific technological pillars. In particular, we found that: i) health promotion is a sustainability topic that agri-food industry address adopting system integration; ii) land use is a sustainability topics that agri-food industry address using simulation technologies and big data analytics; iii) food printing is a sustainability topics that agri-food industry address through additive manufacturing; iv) sustainable agriculture and

circular economy are sustainability topics that agri-food industry address using augmented reality; v) environmental-social-government-themed (esg-themed) megatrend and global megatrend are sustainability topics that agri-food industry address using cybersecurity.

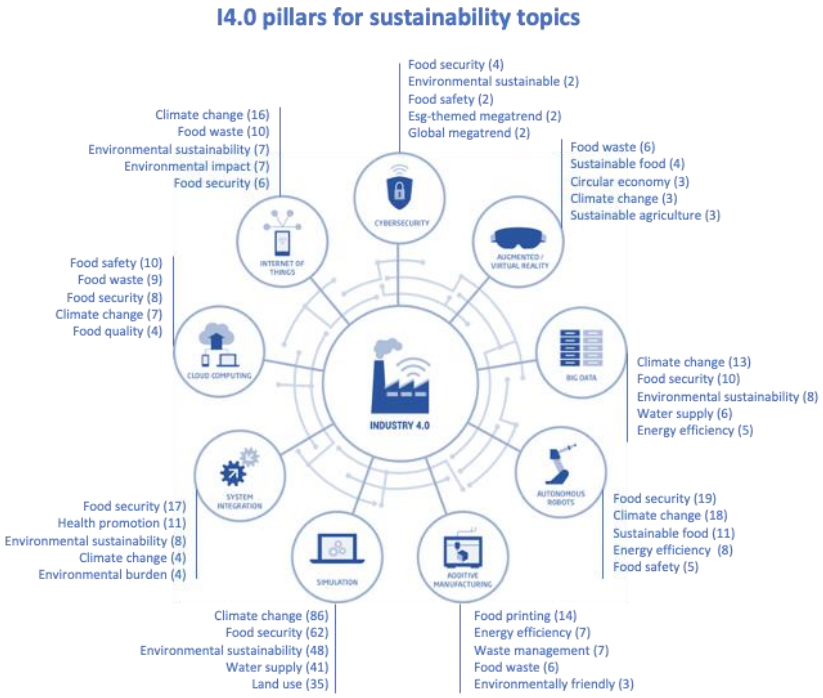


Figure 8: Most frequent bigram occurrences in sub-queries abstracts – sustainability topics (frequency)

Downline these evidences and with the aim of proposing an overall picture of the sustainability topics addressed by agri-food industry using I4.0, the emerging co-occurrence bigrams previously discussed, were reorganized according the relation with the three sustainability dimensions (environmental, social, economic). As Figure 8 shows, the several sustainability topics were grouped in families of topics and listed in order of frequency.

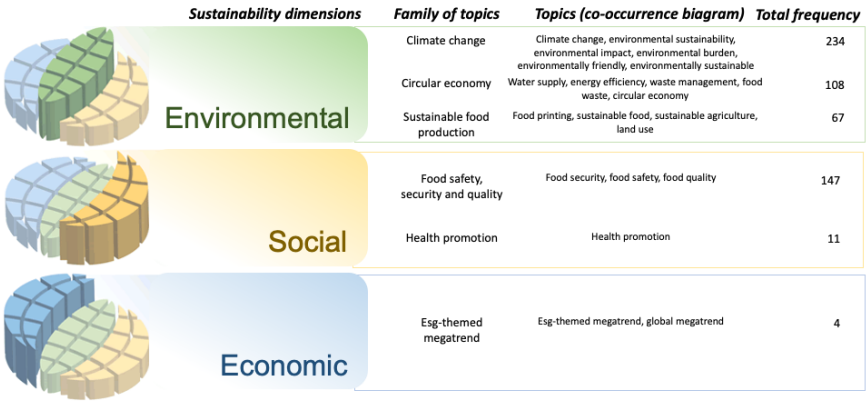


Figure 9 Sustainability dimensions addressed by I4.0

Summarizing, by answering to RQ_3, a variable capability to drive toward sustainability was attested among the 9 I4.0 pillars. Simulation technology resulted the major protagonist for driving sustainability in agri-food sector with particular reference to the environmental one. Social and economic dimensions of sustainability were driven by one or more I4.0 pillars. Attention is given to the only one family of topics in economic sustainability dimensions: esg-themed megatrend which aims to attest and evaluate the economic impact of environmental-social-government changes in sustainability direction. This family of topics was driven only by cybersecurity pillar.

4 Discussion and Implications

The proposed study overcomes the limits and the evidences released by Abbate et al., (2022), providing a systematic literature review based on an inclusive data collection performed in two databases and in a more recent historic period, allowing us to explore how the agri-food digitalization process embraces the sustainability issues moving toward the I5.0. Specifically, thanks to our insights, we can understand how the scientific literature explored the relationship between sustainability, I4.0 and agri-food and, the role of the I4.0 pillars in driving sustainability. The research field is characterized by an increasing attention by academics in the last 2 years, probably related to the regulations introduced recently for stimulating agri-food companies to adopt sustainable practices such as the European Agenda 2030 (EA2030) or the frameworks for sustainable planet established by USA and China (Egan, Raube, Wouters, & Chaisse, 2023). The

geographical distribution of the literature production on the theme and the authors collaboration networks, confirmed the relevance of the topic worldwide.

About the research routes addressed by the research field, the main words able to describe them surround the environmental sustainability sphere with particular attention to the impact that food technology-based production/agriculture could have on it, especially in the saving of natural resources (i.e., water). Numerous are the initiative that agri-food researchers and companies performed in this sense, just think to the investments in Agriculture 4.0 solutions for energy, water, costs, losses saving (Secundo et al., 2022). This effort in sustainable-oriented innovation development enriches agri-food sector and, as attested by Testa, Nielsen, Vallentin, & Ciccullo, (2022), impacts both on organizational and production systems, leading to a profound organizational transformation and radical systemic change and to an incremental improvement in traditional products and processes. In this sense, our cluster analysis highlighted that AFSC management is evolving toward a more technological approach which use AI, machine learning and data analytics to monitor and predict foods quality and safety. At the same time, food production is shifting toward a more sustainable mood, thanks also to technology involvement (such as IoT, simulation model), putting the attention to the production and distribution practices environmental impact.

About the current capability of I4.0 pillars to drive sustainability in agri-food industry, our results attested that simulation technology is widely employed in agri-food sector to achieve environmental sustainability goals such as, climate change monitoring and prediction, improvement of decision making with particular attention to the resources usage (i.e., energy, water, land). This result is in line with the thesis of Utomo, Onggo, & Eldridge, (2018) which reveals that simulation models have the potential to drive sustainability in agri-food sector. Although the environmental sustainability dimension resulted widely driven by one or more I4.0 pillars, social and economic dimensions are it less. This evidence reveals that the transition towards the fifth industrial revolution is in act. I5.0, in fact, is considered as one of the driving forces to enrich the green transition with social and economic expectation (Saniuk et al., 2022). Leveraging on our results, an agri-food digitalization and sustainability roadmap can be supplied (Figure 8). It is a clear overview about how and how much the I4.0 pillars are driving agri-food sector toward sustainability purposes. Climate change is the main issues addressed by the sector involving 7 out 9 pillars (additive manufacturing and cybersecurity seem not be considered for this purpose may be because more

focalized, respectively, to sustainable food production and food security and safety). The importance of this issue is attested also by the EU which dedicated to climate change a specific SDG claimed it as "urgent". Circular economy and sustainable production topics complete the environmental sustainability domain gaining the attention of the sector which leverage on the synergistical use of the all 9 pillars. Food safety, security and quality and, health promotion, are the only two social sustainability topics I4.0-driven, recognized in our study. Them are core goals in the EA2030 which proposed the objective to achieve food security, improve nutrition, promote sustainable agriculture, and to ensure healthy lives and well-being for all. ESG-themed megatrend is the only economic sustainability topic, and it was driven by only cybersecurity. Being ESG a rating system for assessing environmental, social and governance performance of businesses in an economic way, it is strictly linked to the global megatrends described by the EU (Franco, Nicolle, & Tran, 2021). Demographic and social changes, recourse scarcity, inequalities, volatility, scale and complexity, enterprising dynamics, are the five global megatrends which I5.0 are inheriting from I4.0 improving its humanization and sustainability (Esposito & Tse, 2018).

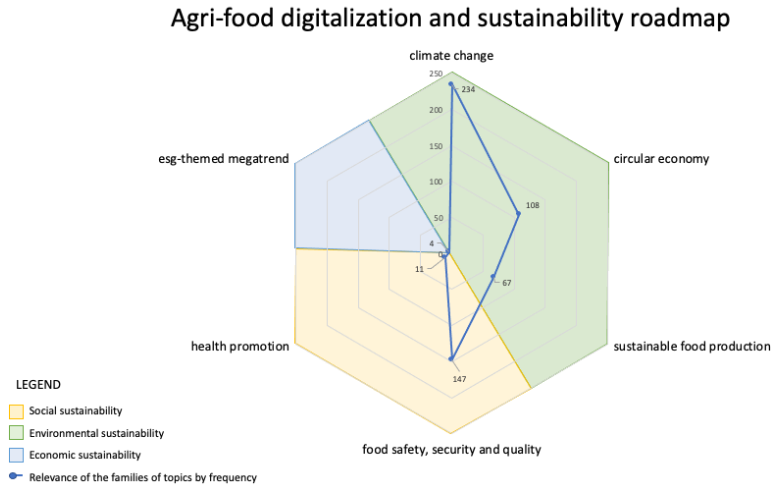


Figure 10 Agri-food digitalization families of topics by frequency and sustainability domains

Research and practical implications emerged. This study is the first to provide a systematic overview and critical appraisal of the ex-tant literature on the role of digital technologies in sustainability practices implementation for agri-food industry. Results could help researchers, academics and practitioners to: i)

understand the research field concepts multiplicity; ii) lay the groundwork for future studies envisaging new research routes; iii) encourage scholars to replicate the study in other industrial sectors.

From a practical implication perspective, the knowledge map created by this study represents for agri-food companies: i) a guide to better understand how to pursue sustainability issues, discovering useful information from the current research routes; ii) a tool to support the adoption of sustainable practices based on technologies toward the implementation of I5.0; iii) a stimulus to explore new sustainability topics by leveraging technology.

5 Closing remarks

The study explored the role of digital technologies during the implementation of sustainability practices in the agri-food industry. We provided the updated picture of the analyzed research topic through the description of its characteristics and its main research routes. Finally, we discovered the capability of each I4.0 pillar to drive sustainability in agri-food industry. Despite that the research methodology was carefully defined adopting PRISMA and widely used software, some limits can be debated: the research could be explained using other databases (e.g., Science Direct), analysis (e.g., semantic analysis), descriptive indicators (quantitative or qualitative), parameters (e.g., frequency threshold) and software (e.g., VOSViewer), integrating different results. Future researches can be performed in order to overcome these limits and enrich the ex-tant knowledge.

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Digital Technologies and Entrepreneurship: The Makerspace as a Knowledge Sharing Enabler

Nadia Di Paola

Department of Economics, Management, Institutions
University of Naples Federico II
Via Vicinale Cupa Cintia, 21 % Complesso Universitario di Monte Sant'Angelo

Mario Tani*

Department of Economics, Management, Institutions
University of Naples Federico II
Via Vicinale Cupa Cintia, 21 % Complesso Universitario di Monte Sant'Angelo

* *Corresponding author*

Abstract

The New VUCA entrepreneurial environment (Millar et al., 2018) asks new entrepreneurs to quickly respond to the ever-changing needs they are targeting with their business ideas.
Entrepreneurs may answer by adopting a lean startup approach (Ries, 2011; Blank and Dorf, 2012; Blank, 2013) that, according to Wang et al. (2022) suggests entrepreneurs to test their assumptions through business experiments (Bocken and Snihur, 2020). In particular, adopting an experimental approach, action-oriented, nimble, and in some case even low-cost, can help get ideas off the ground quicker than usual. Moreover, these processes may be useful in identifying and engaging the first customers (McDonald and Eisenhardt, 2020) and in tackling those grand challenges for which there are no simple and obvious solutions (Yunus, et al. 2010).
According to Furr and Dyer (2014), theoretical and virtual prototypes may help this approach, helping entrepreneurs to get a minimum viable prototype that later may, eventually, evolve into a full-fledged product. The Fablabs - short form for Fabrication Laboratories - are shared spaces open to the public that offer both tools and services for digital manufacturing (Manzo and Ramella, 2015). These spaces give access to sophisticated technologies, so that their users can explore, learn and, obviously, make new things (Rayna and Striukova, 2021).
The possibility of "sharing technology tools in social spaces" is a distinctive trait of the so-called "maker movement", which is based on the interaction, even internet-based ones (Howard et al., 2014), between subjects who use shared resources (technology, spaces, knowledge) to create artefacts (Browder et al., 2019).

In particular, the technologies and the tools that the startuppers and the entrepreneurs may get access to in the Fablab may help them to exploit digital prototypes as a way to reduce the start-up costs, to test and optimise their products in a better and faster way. Furthermore the digital nature of these products may help the would-be entrepreneurs to create an entrepreneurial team that is not limited by the need to be geographically co-located (Capdevila, 2018).
In this work in progress research, we will study a sample of Italian Fablabs, both private ones and university-based ones, to understand how they do participate in helping both the "makers", and the local entrepreneurs, in developing the competencies needed to access to the digital technologies, and to exploit them to implement a Lean Startup Process.

Keywords – Maker Space, Fabrication Lab, Lean Startup, Digital Technologies, New Technologies

Paper type – Academic Research Paper

1 Introduction

The trends in the entrepreneurial scenario call emerging businesses to be able to respond more quickly than before to shifting customer requirements. The lean startup approach seems to offer a response to this call due to the fact that it has the potential to speed up the process of getting ideas off the ground and engaging customers. Fabrication Laboratories, more often known as Fablabs, are collaborative workspaces in which the equipment and services necessary for digital manufacturing are available to the public, in line with the "maker movement," which is based on "sharing technology tools in social spaces."

In this research, we propose to investigate the relationship between the production of artefacts and entrepreneurship. Using a qualitative approach, we analyse a sample of the 98 Italian Active Fablabs that are registered on the fablabs.io digital platform and those created by italian universities as one of their activities in the so-called third mission activities, in order to deepen and investigate the ways in which these spaces facilitate the knowledge transfer and sharing among the actors involved in the makerspace. Using a thematic analysis on a set of interviews with both the "managers" and the "users" of these shared spaces, we will try to understand how these structures can help local area companies, and entrepreneurial ventures as well, to adopt a lean startup approach (Ries, 2011; Blank and Dorf, 2012; Blank, 2013).

The remainder of the paper is organised as follows. In section 2, we develop an initial literature review in order to identify the main themes to investigate in the

empirical part of this ongoing research activity that we end with the proposal of three main research questions that this research project is trying to find an answer to. In section 3, we first present the thematic analysis as the main methodological approach that we are planning to use "make sense" of the complex set of data that we are gathering in the interactions with the sampled Fablabs, and then we report the main information of the data-gathering process that we have developed to answer this research process main questions. In the following section 4, we present the expected results of this ongoing research process, while in the last section, section 5, we provide a initial discussion of the potential implications of the expected results.

2 Literature review

The New VUCA entrepreneurial environment (Millar et al., 2018) asks new entrepreneurs to be able to have a quicker response to the ever-changing needs they are trying to answer with their business idea.

One approach entrepreneurs may adopt to answer our turbulent themes is to adopt a lean startup approach (Ries, 2011; Blank and Dorf, 2012; Blank, 2013) that, according to Wang et al. (2022) suggests entrepreneurs to test their assumptions through business experiments (Bocken and Snihur, 2020). In particular, the authors hold that leveraging an action-oriented, nimble, and in some case even low-cost, experimental approach can help get ideas off the ground quicker than adopting a more traditional one. Moreover, these processes may prove to be useful in identifying and engaging the first customers (McDonald and Eisenhardt, 2020) and in tackling those grand challenges for which there are no simple and obvious solutions (Yunus, et al. 2010).

In any case, experimenters may benefit from both successful and failed attempts, as they may be able to anticipate potential problems and concerns, and the related solutions and, as a consequence, they may be able to get better business models than otherwise (McGrath, 2010). Furthermore, using experiments, startuppers may earlier avoid the risks of offering the market a product that is not able to meet the specific needs of a given set of customers (Eisenmann et al., 2011).

According to Furr and Dyer (2014) the benefits of the lean start-up approach may be amplified leveraging both theoretical and virtual prototypes as a way to reach for a minimum viable prototype that later may, eventually, evolve into a

full-fledged product. The Fablabs - short form for Fabrication Laboratories - are shared spaces open to the public that offer both tools and services for digital manufacturing (Manzo and Ramella, 2015). These spaces aim to provide non-specialists with an access to sophisticated technologies, so that they can explore, learn and, obviously, make (Rayna and Striukova, 2021).

The possibility of "sharing technology tools in social spaces" is a distinctive trait of the "maker movement", which is based on the interaction between subjects who use shared resources (technology, spaces, knowledge) to create artefacts (Browder et al., 2019) exploiting the internet as a way to go beyond face-to-face interactions (Howard et al., 2014).

Recent studies highlight the need to explore further the link between the artifact creation and entrepreneurship outcomes, suggesting several possible paths linking the two (Browder et al., 2019). In this regard, beyond the technological standpoint, which regards the fact that the artefact creation process may enable makers to build prototypes or even market-ready items, they identify additional research directions based on social and knowledge dimensions. For instance, they find that interactions that occur in the making spaces may lead to the consolidation of entrepreneurial teams or to the emergence of potential customers.

According to Browder et al. (2019), digitization was at the root of the MIT Center for Bits and Atoms program that spawned the Fablab network as it help to join the digital and the physical worlds as a continuous whole and helping knowledge sharing, sourcing and creation, making easier to learn new skill and fostering creativity.

Taking a resource-based view (Barney, 1991), and its extension in the knowledge-based view, fab-spaces could be seen as providers of resources and competences.

In particular, the technologies and the tools that the startuppers and the entrepreneurs may have access to in the Fablab may help them to exploit digital prototypes as a way to reduce the start-up costs, to test and optimize their products in a better and faster way. Furthermore the digital nature of these products may help the would-be entrepreneurs to create an entrepreneurial team that is not limited by the need to be geographically co-located (Capdevila, 2018).

Accordingly, we propose to find the answer to three main questions regarding the support that fablabs may give to help entrepreneurs, and startuppers, in adopting the lean startup approach.

RQ1: How do fablabs offer services, not only the technology-based ones, to the local area entrepreneurs and startuppers
RQ2: Which competencies are local area entrepreneurs and startuppers desiring to get from their participation in fablabs?
RQ3: How are fablab related services helping local area entrepreneurs and startuppers to adopt a lean-startup approach?

3 Methods

3.1. Thematic analysis

Thematic analysis is a prominent qualitative research method that uses in-depth data analysis to identify relevant themes (Khokhar et al., 2020). Thanks to the thematic analysis, it is feasible to provide concise data descriptions and interpretations based on observable trends and patterns in the data (Majumdar, 2019).

Thematic analysis necessitates performing an in-depth analysis of qualitative data, which then has to be sorted and categorised. After that, the process of coding entails compressing the data into smaller, more easily interpretable units that are referred to as codes. These codes are then considered as themes (Khokhar et al., 2020). In order to ensure that theme analysis is applied in an acceptable manner, Braun and Clarke (2006) have suggested a six-step process that is commonly utilised (Majumdar, 2019). These include fundamental phases of the analysis, such as becoming familiar with the data, coding, the development themes, and interpretation. These steps indicate that the researcher read the data several times in order to become comfortable with them, that data pieces are identified and assigned a meaningful code, and that the researcher then builds themes and subthemes by expanding on the codes and their context (de Farias et al., 2021).

The use of thematic analysis is suitable for a wide variety of research contexts because of its versatility and flexibility. Thematic analysis is applicable to both qualitative and mixed-methods research designs, and it enables the generation of novel hypotheses and insights that may be evaluated further in subsequent research using a variety of research methods (Alhojailan & Ibrahim, 2012). It is appropriate for use in both an inductive and a deductive approach, and it is

possible to integrate theory-driven codes with data-driven codes in a mixed research strategy (Fereday & Muir-Cochrane, 2006).

Due to its theoretical openness, its adaptability, and its capability to give rich and full answers to the social phenomena being studied, thematic analysis has become more popular as a tool for conducting qualitative research in the field of social sciences (Majumdar, 2019) In the field of study on entrepreneurship, thematic analysis has been utilised in a number of different studies. For example, Lián (2015) and Ali (2021) use thematic analysis to investigate and classify the relevant literature regarding entrepreneurial goals and sustainable entrepreneurship, respectively. They do this by focusing on the similarities and differences between the various studies. Some researchers use thematic analysis to trace the growth of entrepreneurial research on specific issues, such as cultural entrepreneurship (Burger, 2020). This allows them to discover gaps in the research as well as trends in the field.

3.2. Data gathering

In order to understand how the answers to the social phenomena being studied, we propose to study a sample of the Italian Active Fablabs, looking at both the fablabs that have been listed in the fablabs.io digital platform, and those that have been created by the italian universities in their "third missions" initiatives.

In particular, in Italy there are slightly more than 100 fablabs. 98 of them are part of the international fab-labs global network that has been created as a way to spread the ideas and the concepts behind the need to share common tools and processes, as a way to create a world-wide distributed network of laboratories for research and invention (i.e. fablabs.io). The main details are reported in the following table 1.

Table 1 - Distribution of Fablabs in the fablabs.io global network

State	Italy	Worldwide
Active	98	1305
Planned	15	208
Corona	0	24
Closed	5	59

In particular the data on fablabs.io, shows that in Italy, in the first months of the 2023 there are 98 active fablabs (7.5% of those active in the world) and 15 more are planned to be opened in the next few months (7.2% of those that have been planned in the whole world in the next few months according those that have been listed on fablabs.io).

Then there are other fablabs that have been created by the italian universities in their third mission activities or as separate entities (e.g., University of Bolzano has created the BITZ to provide services to the local area entrepreneurs and startuppers) or as internal research centres (e.g., University "Gabriele D'Annunzio" - Chieti/Pescara have a research centre in their Architectural Department that offers the services of a Fablab). Furthermore, only 8 of the italian universities have created a network to group their fab-labs, the U-lab network initially founded by Polifactory (i.e., the fab-lab of the Politecnico di Milano) and the Santa Chiara Lab (i.e., the fab-lab created by the Università di Siena) as a way to create a network of the italian university-based makerspace in order to make them more effective by sharing their best-practices, and to develop operational synergies, and to co-develop cultural and experimental activities.

4 Expected Results

The research protocol defined to gather data, prescribes that, for each of the fab-labs, we will have to interview above all those in charge of the fablab operations (i.e, the responsible managers or the director according to the organisation of the specific fablab). This first interview is needed to get a first-hand report of the services that these structures are offering to the local area entrepreneurs and startuppers. In particular the interview will investigate not only the main technologies that the fab-lab may offer, such as those related to the additive manufacturing technologies (e.g., FDM, DLP, SLS, 3d printing machines) or more traditional ones (e.g., CNC machines, and laser engravers) but even those more related to the digital technologies such as Arduino, and the other more advanced microcontrollers, and the related programming languages. In particular the interview will highlight, from the fablab point of view, how the makerspace is able to help the local area entrepreneurs, and startuppers as well, to leverage the new digital technologies to adopt a lean-startup approach that may effectively leverage digital and physical experiments.

This first set of interviews will help us to find the data to study in order to answer the first RQ and to have the first perspective on the third RQ.

Furthermore, during these interviews we will get the needed information to contact the users of the fablab services in order to hear the other side of the value co-creation: the users. In particular our research will target both local area entrepreneurs, usually the owners of local SMEs that have decided to interact with the fablab to learn how to use one or more specific technologies, and startuppers, both as new entrepreneurs and as potential ones. In both cases, the interviews will be driven to understand how the users are interacting with the makerspace, which services they use the most, which competences they were trying to develop and how these new competences should help them in their ventures, and last but not least, which new relationships they have developed though these interactions (in order to understand if, and how, they are using an open-innovation approach). Through these interviews, and the related thematic analysis, we do not only want to find evidence to corroborate the results of the analysis on the first set of interviews, and provide the primary ground to answer RQ2, but we use them to start gathering the data for giving an answer to the third RQ from the user's perspective.

5 Discussion and Conclusions

This research should help to understand how a makerspace may help local area entrepreneurs to get access to an heterogeneous set of resources and competences that may be leveraged to adopt a lean startup approach.

The results should be able to give useful hints to both managers, fablabs, policy makers, and academicians as well.

From the managerial perspective the research tries to provide a guide to highlight some best practices in integrating the different services in order to improve the value co-creation potential of enterprises and startups. At the same time, this information may be used to provide guidance to the fablab organisations to help them to look at what is happening in other italian regions, to improve their understanding of the local area evolution, and, as a consequence, be more effective in providing needed services according to the specific needs that may develop in their area .

The results are potentially interesting to the policy makers as well. Depending on the results, this research may provide useful information on which

technologies to support in public competence-development programmes not only to help the existing enterprises, that often may be blinded by knowledge myopia (Levinthal & March, 1993), but to help creating a stronger startupper movement.

Finally this research may provide useful information for the academicians as well, not only the italian university may use the evidence gathered for this paper to decide how, and using which approach, they may start participating in the maker movement, but even to provide new evidence for the real effectiveness of the lean startup approach in the various Italian contexts that may be later used to define new research propositions that may explore how the various competences may be better developed in different contexts.

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Artificial Intelligence for the Customer Experience: Developing a Digital Human for Banking using Algho Platform

Giustina Secundo

Department of Management, Finance and Technology
University LUM Giuseppe Degennaro
Strada Statale 100, 70010 Casamassima (BA), Italy

Claudia Spilotro*

Department of Management, Finance and Technology
University LUM Giuseppe Degennaro
Strada Statale 100, 70010 Casamassima (BA), Italy

Carmelo Antonio Ardito

Department of Management, Finance and Technology
University LUM Giuseppe Degennaro
Strada Statale 100, 70010 Casamassima (BA), Italy

Felice Vitulano

QuestIT
Via Leonida Cialfi, 23, 53100 Siena (SI), Italy

* *Corresponding author*

Abstract

The study aims to assess the potential of artificial intelligence (AI) for improving the customer experience in the banking sector by designing and developing a digital human sustaining the customer care. Digital humans are conversational robots that have transformed traditional human-human interactions into new disruptive machine-human interactions that are more reliable and exceptional, but also fragile. The study analyses Algho, a virtual assistant platform developed by QuestIT company, to automate the banking customer care service, and in particular the loan request. The key aspect of this process was creating and consolidating an effective Knowledge Base, the indispensable basis for a successful performance of the digital human. The research evaluates the performance of the virtual assistant, equipped with a digital human interface, through the creation of an Algho tester that can verify the effectiveness of the knowledge base. The

results show that AI-based technologies can have a positive impact on business processes. The originality of the study lies in the training of a digital human according to business needs with a perspective of creating an optimised customer experience.

Keywords – digital transformation, digital marketing, artificial intelligence, customer experience, innovation

Paper type – Academic Research Paper

1 Introduction

Digital transformation is "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" (Vial, 2019), which allows artificial intelligence-based technologies to emerge and be applied to support business activities and processes. Artificial intelligence (AI) supporting the customer experience is revolutionising the way companies interact with consumers (McLean and Osei-Frimpong, 2019). By developing AI technologies strategically, several key touch points can be triggered that could bring significant benefits to companies and the possibility of increasing customer satisfaction. In this context, chatbots emerge that act as a gateway to an immediate and satisfying experience and, by incorporating machine learning functions, learn from their own "mistakes" and user behaviour (Tebenkov and Prokhorov, 2021). The advantages of using chatbots are many, the most important of which is the 24/7 availability, i.e. the immediacy of such tools that can offer services at any time, leading the company to improve customer satisfaction and consequently its brand reputation.

The evolution of chatbots is represented by *"Digital Humans",* which go beyond the obsolete concept of chatbots by embodying humanoid forms to relate with the customer in a more empathetic way (QuestIT, 2023). Digital Humans are conversational robots that represent the empathic evolution of virtual assistants. These tools are of enormous importance not only in the economic sphere but also in the social sphere, as they have transformed traditional human-human interactions into new disruptive machine-human interactions that are more reliable, exceptional but also fragile (Kaczorowska-Spychalska, 2019), in which a crucial part is the creation of trust (Przegalinska et al., 2019). The anthropomorphic nature of the digital human under analysis highlights a number

of psychological consequences that can potentially increase the engagement of the user with which it interacts (Alabed et al., 2022; Go et al., 2019), but can also occur a negative impact as a result of the chatbot disclosure, driven by a subjective human perception against machines, despite the objective competence of AI chatbots (Luo et al., 2019).

Despite the growing interest in the applications of Digital Humans for improving the customer experience, the role of digital technologies in improving the customer service experience through the adoption of digital human tools is still in an infancy phase. With the aim to cover this gap, the purpose of this paper is to assess the strategic potential of artificial intelligence for improving the customer experience (Ameen et al., 2021) in the banking sector. The aim is to design and develop a digital human, as a fintech application tool (Zarifis and Cheng, 2022; Hwang and Kim, 2021), as well as a digital marketing leverage (Paschen et al., 2019). Through the realisation of a virtual assistant trained for the purpose of automating the financing process on a banking platform, the advantages, opportunities and limitations of the research will be analysed. The crucial point in this process is the elaboration of a well-structured Knowledge Base, the indispensable basis for an effective performance of the digital human, which will be verified by the creation of a Knowledge Base tester.

Findings show that integrating AI systems can positively impact business processes.

Hence, the remaining sections of this paper are organised as follows. Section 2 presents an overview of the current literature, section 3 presents the research methodology. Then, section 4 is dedicated to the exposition of the findings, section 5 discusses the results in the light of the existing literature and section 6 concludes the paper by highlighting the implications.

2 Literature background

Artificial intelligence found its roots in 1950, with the publication of the article "Computing machinery and intelligence" written by Alan Turing on this avant-garde topic. It developed concretely from the 1940s onwards, a period in which the term "cybernetics", i.e. the discipline that deals with the study of processes concerning "communication and control in the animal and in the machine" (Wiener, 1948), became widespread.

In order to meet consumers' needs, financial intermediaries can deploy digital technologies that optimise operational processes, especially AI technologies that can speed up credit recovery activities, reduce credit management costs, optimise more complex processes, maximise performance, and enhance touchpoints for customer care services.

2.1 AI-enabled tools: Digital Humans

The main AI technology supporting customer care services is chatbots, 'intelligent agents' (Turing, 1950; Poole and Mackworth, 2010) based on systems aimed at communicating with users using natural language processing (Adam et al., 2020); they are designed to imitate human speech in approximating written text or vocal speech as best as possible to interact with people via a digital interface (Ling et al., 2021; Thomaz et al., 2020). They become the technological reflection of humans leading to "the dehumanisation of what is human and the humanisation of technology in all its manifestations" (Kaczorowska-Spychalska, 2019).

As a result, chatbots are gradually replacing human service agents on websites, social media platforms, and messaging services. According to industry experts, the market for chatbots and related technologies is projected to surpass $1.34 billion by 2024 (Wiggers, 2018). While some experts argue that chatbots can improve customer service while also reducing costs (De 2018), others fear that they may have a negative impact on firms and customer service (Kaneshige and Hong 2018). Hence, determining the optimal design and implementation of chatbots for customer service purposes remains an open question, as businesses weigh the benefits and drawbacks of these tools in delivering efficient and effective customer service (Crolic et al., 2021).

The shift from chatbot to digital human represents a move towards creating AI systems that can simulate human-like interactions, emotions, and behaviours to a greater extent than current chatbot technology. A digital human goes beyond the scripted responses of a chatbot and can respond more naturally to complex queries and even understand nonverbal communication such as facial expressions, tone of voice, and body language. The development of digital humans involves using advanced algorithms and machine learning techniques, including deep learning and natural language processing, to create more

sophisticated and personalised interactions with users, as well as being equipped with a digital human interface (QuestIT, 2023).

2.2 Digital Humans in the banking sector

The digitalisation of businesses, in which digital technologies are used to change business models and create new revenue opportunities, is transforming the way that service providers and customers interact (Oviatt and Cohen, 2015; Hennig-Thurau et al., 2010; Pousttchi and Dehnert, 2018; Schmidt et al., 2017). As new technologies emerge, it can be assumed that the digitalisation-enabled transformation in services will be even further amplified (Gomber et al., 2018). The financial service sector has already experienced the impact of digitised services such as mobile wallets, payment apps, and automated wealth advisors that have entered the market as replacements for established banking services (Basole and Patel, 2018). To fully realise the potential of digitalisation-enabled service transformation, it is important for those leading the transformation to see its potential from a customer perspective (Kandampully et al., 2021; Lähteenmäki et al., 2022).

The finance industry has been at the forefront of utilising AI technology, including chatbots, and is seeing an increase in the number of financial institutions adopting chatbots to enhance customer service (Adobe, 2019; Sarbabidya and Saha, 2020; Suhel et al., 2020). This has led to progress in research on chatbot technology in the finance industry, with many researchers studying algorithms and systems that reflect the unique characteristics of the industry. Financial firms face challenges in providing customers with the right information due to the complexity of the financial system, resulting in time and labour lost on simple inquiries (Chaitrali et al., 2017). Chatbots have been proposed as a solution to answer frequently asked questions using natural language processing (NLP), providing customers with quick and efficient service (Elcholiqi and Musdholifah, 2020; Rajbabu et al., 2019; Yu et al., 2020). Several banks have embarked on a digital transformation process (Zhang, 2021), and chatbots are widely recognized as a vital and necessary element of this transformation, as well as a sustainable strategy for the development of the banking industry (Forbes, 2021). Chatbots are frequently employed by banks in their marketing efforts, sales activities, and customer relationship management practices (Eren, 2021), enabling them to deliver quick, affordable, and customised services to their customers.

Nguyen et al. (2021) suggest that to keep customers using chatbot services in banking, providers must ensure their chatbots are trustworthy, useful, and meet customer needs. They can do this by focusing on three quality aspects of chatbot services: information quality, service quality, and system quality. Information quality is critical for users' trust and satisfaction, and providers must offer relevant and up-to-date information. Service quality is essential to provide accurate information and prompt responses to users' queries. Personalised services, addressing customers by name, can alleviate uncertainty and build trust. System quality is the most important factor in building users' trust in chatbots, and banks must provide a stable, attractive, and adaptable interface with 24/7 support. Additionally, they must consider systematic risk and users' privacy when developing chatbots, particularly in emerging markets with weak legal protection. Providing high-quality chatbot services can result in many benefits for banks, such as a good reputation and positive image.

Digital Humans are the right tool for banking customer care as they facilitate navigation, provide live insights, are multimodal, predictive, inclusive, and optimise work, automating first-level processes, facilitating the work of operators and reducing costs (QuestIT, 2023).

The study therefore aims to enrich the existing literature with more knowledge on the shift from chatbots to digital humans, by describing the key features of these innovative AI-enabled digital tools. The focus of the work is on the automation of banking customer care, thanks to the Algho platform, to examine the potential impact of digital humans on the customer experience.

3 Research methodology

The study adopts the case study (Yin, 2003) of Algho, a technology produced and developed by QuestIT and a registered trademark of The Digital Box. Algho is a virtual assistant, based on latest-generation 3D technology with human features, with the aim of creating an empathic relationship with the user and thus establishing a new and effective User Experience. *The research question driving this study is: How does the implementation of Digital Human for banking impact the customer experience?*

To address this question, a digital human was created and developed using the Algho Platform in order to automate the financing process on a banking website. Fundamental in this phase is certainly the process of creating and consolidating a

"Knowledge Base" capable of understanding and solving the user's specific problems and earning the user's trust. To evaluate the effectiveness of the virtual assistant, an Algho Knowledge Base tester was created to optimise the performance.

4 Findings

The first step in proceeding with this study was to realise the digital human according to business needs. We proceed to choose the name, the voice, the language, the gender. We then proceeded to insert a welcome and welcome back message. The digital human was created and trained completely in Italian, as the bank for which it was developed is Italian.

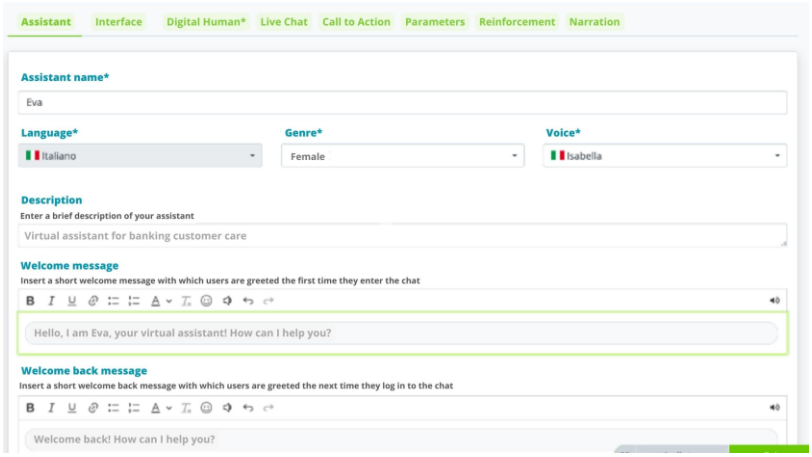

Figure 12. Creation of the Digital Human

Next, we set the colours of the chat, the company logo and settings related to the speed of the assistant's response. The latter setting allows you to set a slower response type, if you are trying to simulate human interaction, or a faster one.

There is the possibility of setting up the 'Live chat' function, which allows a human operator to enter the chat and replace the assistant in the event that the user, for example, asks to interface with a real person, or in the event that after a pre-set total of questions that the digital human is unable to answer, the automatic call to the human operator starts. By means of the 'Parameters' setting section, one can set the degree of flexibility, confidence and correspondence one wishes to give the virtual assistant. Specifically, the correspondence refers to the degree of importance the digital human attaches to the semantic and syntactic

component in order to provide the most suitable answer to the question received from the user. The "Reinforcement" section allows the user to set various types of learning that the assistant can perform automatically. This function allows the user to rate the digital human's answer positively or negatively, thus making him/her remember whether a particular answer was useful or not in order to help him/her with future questions. The risk, however, is that the answer is voted negatively even if it is correct, for whatever reason or problem not arising from the chatbot.

After setting these technical settings, we entered the phase of creating the knowledge base of the digital human. The platform provides pre-set basic questions for small talks, and to create custom questions, one must formulate the question and enter an appropriate answer that satisfies different variations of the question. Conversational forms can also be added, along with a link function to guide users to relevant pages. Multiple answers can be created for a single question and targeted according to the user's focus. To train the virtual assistant, indirect or direct information can be sought to convert the user into a customer. Trust and a suitable tone of voice must be established to adapt to a broader range of customers, especially in the banking sector. A solid knowledge base must be created to understand and solve the user's specific problems, building trust with the user.

The Knowledge Base Test was the key point to improve the virtual assistant's ability to answer questions correctly. In fact, thanks to this test, which was carried out by entering all the questions in the virtual assistant's Knowledge Base with variants that a user could ask in an excel file uploaded directly to the Algho platform, the latter provided the result as a percentage of this performance. Thus, the Knowledge Base was optimised until a 100% performance result was obtained.

5 Discussion

In our study, we examined the historical evolution of chatbots and how they have now turned into Digital Humans, conversational robots that represent the empathic evolution of virtual assistants. Specifically, we analysed the case study of the Algho platform, which gives the possibility of training a Digital Human to assist users by reshaping the User Experience.

Then, we designed and trained a Digital Human for banking customer service, working on the possibility of optimising banking processes such as a loan request. This process represents a great advantage for the market, giving the possibility of optimising costs and employing human resources in more complex and difficult to predict activities. Several studies indicate that the use of such AI tools offers substantial advantages, especially with regard to interactions with customers, who form more personal bonds with robots than with an AI without a physical embodiment.

A wide range of potential functions and advantages offered by chatbots are the subject of reflections that will certainly be deepened in the coming years, in the face of new interactions with customers that represent an interesting win-win. The customer in fact obtains a constantly evolving 'product' that satisfies his needs, and companies are motivated to optimise it to increase the customer lifetime value (Kaczorowska-Spychalska, 2019).

The provision of accurate, timely, and pertinent information by chatbots can enable users to make prompt and accurate financial decisions. Users are likely to experience increased satisfaction when they perceive chatbots as trustworthy (Gao et al., 2015). Notably, the quality of service is the primary determinant of user satisfaction (Nguyen et al., 2015).

According to Nguyen et al. (2015) customers tend to continue using chatbot services only if they perceive them as reliable and useful and if their needs are met. Therefore, banking service providers should pay close attention to three key quality aspects of chatbot services - information quality, service quality, and system quality - and ensure that users' expectations are met. Understanding customers' expectations is a vital first step for banks to provide timely solutions that satisfy them. Hence, to promote customers' intentions to continue using chatbot services, their expectations must be met or even exceeded. Furthermore, given the significant role of perceived usefulness in the relationship between satisfaction and continuance intention, banks must ensure that their chatbot services are error-free, as service failures can prevent customers from getting what they are looking for, causing dissatisfaction. Banks should also anticipate users' most common questions or requests and program chatbots to perform their tasks efficiently. In addition, interactions between users and chatbots should be efficient and user-friendly (Nguyen et al., 2015).

Endowed with personality and based on self-improvement mechanisms, Digital Humans could become our faithful reflection in the future (Kaczorowska-Spychalska, 2019).

6 Conclusion and implications

Having created and trained the virtual assistant, the enormous potential of such a tool emerged, as not only does it have a simple and intuitive interface, it also allows the digital human to be trained and tested in an iterative manner. This makes it possible to constantly improve its performance in order to offer the user an innovative and immersive customer experience.

The main managerial implications that emerge from our study are first the possibility of automating certain processes currently entrusted to human resources so that certain business activities and processes can be optimised. Second, a growing awareness has emerged with respect to the benefits that these tools can bring, but a low ease of use, so the focus on which there is a need to work is on increasing knowledge of these technologies. In addition, future research, building on the implications of our study, could deepen this topic by analysing the psychological factors underlying human-machine interactions to improve and optimise the customer experience, reducing the current resistance with respect to these technologies and thus increasing the propensity to adopt them.

The ideal evolution of the project we have outlined is represented by the future possibility of placing one's trust in AI tools that, in a completely automated manner, can on the one hand provide all those operational banking services such as applying for a loan, opening an account, or requesting a debit or credit card, and on the other hand also provide all those advisory services that, based on the customer's need and financial situation, can help him or her orientate themselves in the investment choices that are best suited to them.

Underlying possible future developments is an awareness on the part of individuals of how such technologies can improve their customer experience. Furthermore, in an optimal process improvement and optimisation in addition to automating the totality of banking services, a possible future development that would be of incredible importance is the possibility of automating customised advisory services according to customer requests. This process would be the natural evolution of the so-called robo-advisors, i.e. those tools that are aimed at

providing investment solutions in a totally, or almost totally, automated manner; in order to improve the customer experience supported by artificial intelligence tools.

Future research could also analyse and test the reaction and behaviour of users when using such a tool, in order to better understand the role of artificial intelligence on the customer experience.

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The Effectiveness of the "*Out of Core*" Discoveries: Serendipity in the R&D of Rare Diseases and "Orphan Drugs"

Rossella Canestrino*

Parthenope University of Naples
Via Generale Parisi 13, 80132 Naples (Italy)

Angelo Bonfanti

University of Verona
Department of Business Administration
Via Cantarane 24, 37129 Verona (Italy)

Francesco Caputo

University of Naples 'Federico II"
Department of Economics, Management and Institutions
Via Cintia, 21 – 80126 Napoli (Italy)

Elias G. Carayannis

The George Washington University School of Business
Department of Information Systems & Technology Management
515 Funger Hall, 2215 G Street NW,
GWUSB, Washington, DC 20052, USA

Pierpaolo Magliocca

Department of Humanities
University of Foggia
Via Arpi 155, 71121 Foggia (Italy)

** Corresponding author*

Abstract

Serendipity – the notion of making unexpected and valuable discoveries – and knowledge arbitrage have played a significant role in the debate about innovation and innovation effectiveness, opening a considerable discussion about the feasibility of R&D investments. The chance to detect serendipitous events and the mechanisms triggering it may attract

the attention of those seeking greater efficiency in research and those aiming to sustain basic research. Depending on the above, our research focuses on the serendipitous events and knowledge arbitrage in the R&D of rare diseases and orphan drugs to detail the market opportunities and the economic value arising from the untargeted discoveries. The Tigem research center in Pozzuoli (Italy) is engaged as a case study to achieve this purpose. Since no previous researches are available about the serendipity in R&D of rare disease, this paper provides new knowledge in a still underexplored field, offering new insights at both theoretical and practical levels.

Keywords – Serendipity; R&D; pharmaceutical industry; rare diseases; orphan drugs

Paper type – Academic Research Paper

1 Introduction

Innovating is always risky, as introducing something new (not existing before) always involves a reasonable chance of failure. Therefore, '*The willingness to commit resources to projects, ideas, or processes whose outcomes are uncertain*' – risk-taking (Covin and Wales, 2012, p. 694) – may reasonably affect the investors' propensity to engage in risky/innovative activities. It is especially true for industries with high research and development (R&D) investments, such as pharmaceutical and biopharmaceutical industries. Both pharmaceutical and biopharmaceutical companies spend massive amounts of money on R&D to discover new drugs. They also face significant uncertainty across the whole value chain, from drug discovery to post-launch pharmacovigilance. After having found a new drug, the companies can exploit the exclusive marketing rights for a period as a reward for their R&D efforts[1]. Unsurprisingly, the allocation of resources in the pharmaceutical and biopharmaceutical industries is usually driven by the expected returns on investments. Thus, the potential market size is crucial in addressing R&D investments in both sectors (Gamba et al., 2019). This evidence finds support in the research results by Dubois et al. (2015) and Acemoglu and Linn (2004), who confirmed a direct relationship between the potential market size and the development of new drugs. Following the above considerations, pharmaceutical and biopharmaceutical companies are reluctant to invest in rare diseases, mainly because of cost and the uncertainty linked to developing orphan drugs (it takes about ten years on average to discover and market a new drug to

1 Once the drug comes off patent, generic drug manufacturers can produce and sell the drug at a significant discount. This circumstance reduces the profits for the company that first invested in the R&D.

treat a rare disease) and the reduced market opportunities, the last ones limited to a small patient population.

Rare diseases affect a few people compared to the general population, and specific issues are raised concerning their rarity. Nguengang Wakap et al. (2020) estimate that the number of people worldwide living with a rare disease is 300 million. Notably, in Europe, a rare disease affects one person per 2000[1]. In 2021, research and development spending in the pharmaceutical industry was about 238 billion U.S. dollars globally[2], with only 11% of new drugs expenditure addressed to the treatment of rare diseases and orphan drugs[3]. Moreover, Gamba et al. (2019) revealed that while R&D has increased over time for all orphan diseases, the increase has been much more remarkable for the less rare.

This gap opens a considerable debate among academia, institutions, and civil society on triggering private and public investments toward R&D in rare diseases and orphan drugs. Mainly, we sustain the idea that market opportunities may arise from unexpected and beneficial discoveries in R&D, claiming a new evaluation of the profitability of the original investments. Carayannis (2008; 2011; 2011a; 2014; 2014a; 2015; 2016; 2019; 2022) labels these "happy accidents" and considers them derivatives of Strategic Knowledge Serendipity and Arbitrage instances to emphasize the role of an individual's ability to identify, accessing, and integrating the knowledge arising from serendipitous events and employing it to get defensible, sustainable, and financial benefits. The most famous 'happy accident' in the past was the fortuitous detection of penicillin by Alexander Fleming in 1928, but hundreds of unexpected discoveries characterize the history of innovation. Serendipity was prominent in discovering many drugs and medical treatments, including vaccination, insulin to treat diabetes, penicillin, quinine, and Viagra. It was also crucial in many fundamental discoveries, including x-rays, radioactivity, pulsars, and cosmic microwave background radiation, and in finding many valuable products such as Teflon, vulcanized rubber, microwave ovens, and velcro. In 2006, Thomas Ban found that *serendipity was one of the many factors contributing to drug discovery*.

In line with the above considerations, our research focuses on the serendipitous events and knowledge arbitrage in the R&D of rare diseases and

1 Source: https://www.orpha.net/consor/cgi-bin/Education_AboutRareDiseases.php?lng=EN
2 Source: https://www.statista.com/statistics/309466/global-r-and-d-expenditure-for-pharmaceuticals/
3 Source: Report: Orphan Drugs in the United States: Rare Disease Innovation and Cost Trends Through 2019. IQVIA Institute for Human Data Science, December 2020

orphan drugs. The final aim is to detect and detail the market opportunities and the economic value of the 'not targeted' discoveries. In so doing, we focus on the research activities held by Tigem. Tigem is a Telethon Foundation research center in Pozzuoli, Italy. It comprises several research groups and over 200 staff members dedicated to understanding the molecular mechanisms behind rare genetic diseases and developing novel treatments. Recently, one of the Tigem research groups identified a novel disease–gene association in the autism spectrum disorder (gaining a new goal in the research of rare diseases) thanks to the genomic surveillance of the acute respiratory syndrome coronavirus 2 (SARS-CoV-2)[1]. Because of its focus on rare diseases and the efforts paid to attract external funds, Tigem should likely generate rich information on the phenomena which aims to explore, justifying its selection in our research (Miles and Huberman, 1994).

Following Shorten and Smith (2017), we designed a mixed method (exploratory sequential) to reach our final goals. Given the complexity and multi-step nature of our research process, in this conference's context, we mainly explain the results arising from the first step of our investigation (qualitative data collection and analysis).

The paper is organized as follows: after reviewing the literature on *Serendipity* and *Knowledge Arbitrage* and their impacts on rare diseases and orphan drugs, the study method and the selected case study are detailed. Thus, the first results are presented and discussed. The paper ends by providing implications, limitations, and directions for the forwarding research steps.

2 Serendipity, Knowledge Arbitrage, and discoveries

In 1754, Horace Walpole introduced the word serendipity to label '*the faculty of making happy and unexpected discoveries by accident*'. As known, Walpole was a prolific inventor of new words. However, it could not imagine that the Oxford Dictionary would have declared 'serendipity' one of the ten most difficult English words to translate (2004), nor that it would become the core of a vast scientific analysis aiming to understand its mechanisms and antecedents (Wareham et al., 2022; Garud et al., 2018; Yaqub, 2018).

1 The Tigem group developed an optimized and cost-effective strategy to monitor SARS-CoV-2 genetic variability without automation.

Several scholars (Wareham et al., 2022; Garud et al., 2018; Yaqub, 2018; Carayannis, 2014, 2008; De Rond, 2014) consider serendipity no longer a pure lucky event nor a random process. In contrast, 'there may be important combinations of factors affecting its occurrence and scope for altering its prevalence' (Yaqub, 2018, p. 175), able to impact, lastly, the effectiveness of the overall un-targeted R&D. Therefore, understanding serendipity, its mechanisms, and antecedents is the first step to look for a new balance in the rationales triggering investments in targeted and un-targeted research.

Serendipitous events arise in basic science, applied research, and technological development activities. Definitions of *serendipity* may be found in several research contexts: information (Agarwal, 2015); science and technology (Andel, 1994; Merton, 1984); organizational learning and innovation (e Cunha et al., 2010; de Rond, 2014); innovation ecosystems (Carayannis, 2014; 2008); creativity (Austin, 2003); entrepreneurship (Dew, 2009); recommendation systems (Kotkov et al., 2016); and medicine (Scherman and Fetro, 2020).

Serendipity generally means discovering something we are not in quest of (Merton and Barber, 2004).

The most extensive exploration of *serendipity* started in the 40s. At that time, Robert K. Merton began his project to chart serendipity's lexicographical history and sociological semantics. Pursuing his research aims, Merton collected hundreds of examples of serendipitous events and detailed writing notes about the phenomenon. Recently, Yaqub (2018) has reviewed Merton's archives and has been able to classify *serendipity* on the bases of the nature of the inquiry (targeted/non-targeted) and the result of the discovery itself (type of solution discovered: solution to the target problem/solution to an un-targeted problem).

Notably, the authors identified the following:

1. The *Walpolian serendipity*: discovering something which the researcher was not looking for (solution to a different/un-targeted problem)
2. The *Mertonian serendipity*: discovering something which the researcher was looking for through an unexpected path (targeted problem/different path);
3. The *Bushian serendipity*: discovering a not sought-for solution (un-targeted research solves an immediate problem)
4. The *Stephanian serendipity*: discovering something that does not directly solve an instant problem but could solve a problem in the future (un-targeted research solves a problem later)

The above typologies are presented in Table 1. The nature of the inquiry (targeted research vs un-targeted research) and the research outcome (solution to targeted problem vs solution to the un-targeted problem) are reported in the table's headings.

Table 2- Types of serendipity

		NATURE OF THE INQUIRY	
		TARGETED RESEARCH	*UNTARGETED RESEARCH*
RESEARCH OUTCOME	*SOLUTION TO UNTARGETED PROBLEM*	Walpolian	Stephanian
	SOLUTION TO TARGETED PROBLEM/UNEXPECTED PATH	Mertonian	Bushian

Source: Yaqub, 2018

In the same vein, Busch (2020) detected three types of serendipity based on the nature of the inquiry (the researcher is already looking for something or not) and the research outcome (expected discovery vs unexpected discovery). Björneborn (2017), and Bogers and Björneborn (2013) distinguished between 'foreground serendipity' (arising from the researcher's direct focus) and 'background serendipity' (arising from a change in the researcher's focus) based on how research interests (preoccupations/foreground interests vs background/latent interests) are prompted.

In general, the researchers recognize the typologies mentioned above only after they have occurred (Wareham et al., 2022; Yaqub, 2018), and, as in the case of Stephanian serendipity, the discovery may find its usefulness and applications only time later, sometimes in different research areas, influencing the investigators' ability to value its effectiveness. In contrast, more helpful information arises by examining the processes and the mechanisms supporting the emergence of serendipitous events. Notably, Yaqub (2018) identified four mechanisms through which 'happy accidents' may arise: according to the scholar, serendipity may be *theory-led*, *observed-led*, *error-born*, and *network-emergent*. These mechanisms suggest as many recommendations to foment serendipity.

Examining the deviation from the theory is the first source of serendipity (*theory-led)*. It means detecting incongruences between output and process and predictions and expectations on the other. In sum, if the theory guides the researcher on where to look, it is only by diverging from conventional and

institutionalized knowledge that the observer widens the scope of its potential discoveries (Åkerström, 2013). Observation is the second source of serendipity (*observed-led*). Notably, observation routines (individual characteristics) and instrumentation availability (context characteristics) affect both individuals' discoveries and their ability to perceive serendipity (Wareham et al., 2022; McCay Peet & Toms, 2015). Depending on this, cultivating serendipity requires both individual-level catalysts (ex.: alertness) and enablers (ex.: cognitive flexibility) and organization-level triggers (ex.: social embedding) (Busch, 2022). Sometimes serendipitous events emerge from errors, mistakes, and forgetfulness. One of the most well-known *error-led* serendipity is the discovery of penicillin. In 1928, Alexander Fleming was exploring influenza when one of his petri dishes became spoiled and grew a mold. Fleming noted that the mold grew in a circle in which no bacteria was found. After isolating the mold, Fleming made liquid to fight bacteria. This drug is known as Penicillin (Ban, 2006). Finally, *serendipity* may be *network-emergent*. Almost all recognize the crucial role of collaboration in fostering innovation and cooperation, enabling individuals and organizations to share what they already know and explore new knowledge (Canestrino et al., 2022). In the same vein, serendipity will likely arise thanks to the interactions between and among several people (e Cunha et al., 2010; Meyers, 2007). According to Yaqub (2018), networks support serendipity, '*bringing discoveries to the attention of researchers who can exploit them*' (p. 174). Nevertheless, networks could also bind serendipity because of a 'bandwagon effect' that limits the researcher's ability to combine different and unrelated information (Busch, 2022). Given the serendipity, it is more likely to arise in a diverse research network, within which the interaction between different fields of knowledge and industries is supported. Social networks can support the emergence of fortunate encounters if they increase the amount and/or diversity of interactions (McCay-Peet et al., 2015; McDaniel & Walls, 1997), thus potentially increasing the surfacing and sharing of unexpected ideas. In this vein, research networks are expected to trigger serendipitous events to the extent to which they support the *knowledge arbitrage*.[1]

[1] *Carayannis (2014) defines knowledge arbitrage as 'the ability to distribute and use specific knowledge for applications other than the intended topic area. More specifically, it refers to the capacity to create, identify, reallocate, and recombine knowledge assets more effectively and efficiently to derive, develop and capture non-appropriable, defensible, sustainable, and scalable pecuniary benefits' (p. 205 – JoKE)*

2.1 The research model in the framework of rare diseases

The European Union considers a disease rare when it affects **less than one in 2,000** citizens. Despite this, the number of people affected by a rare disease is numerous. Up to 36 million people in the EU live with a rare disease. There are more than 6000 distinct rare diseases in the EU. Around 80% of rare diseases are of genetic origin, and 70% already start in childhood. Discoveries leading to new treatments and drugs for rare disease represents a unique challenge. The small patient population negatively affects the market's attractiveness to companies and scientists (Douglas et al., 2022).

Moreover, time and costs associated with drug discovery and development discourage pharmaceutical companies from addressing their investments in less profitable markets (Scherman and Fetro, 2020). Several factors (ex.: the small market size, the high cost of research and development, high failure rates, industry's need to recoup high-risk investments, amongst others) increase the cost of producing new drugs. Additionally, the complexity of regulations (from the lead compound identification to the market authorization) contributes to lengthening the time between the research and preclinical and clinical development. This process takes ten to fifteen years and costs several billion dollars. Under such circumstances, the needs faced by rare disease patients risk remaining unmet because of the inability to fix a sustainable price for the healthcare system. In the face of these challenges, we support the idea that detecting, tracking, and supporting the emergence of serendipitous events in the R&D in rare diseases could add economic rationale for both public and private fundings and address a better combination of *mission-oriented* vs *diffusion-oriented* policies. In the context of this research, we aim to answer the following questions:

RQ1: What and how many serendipitous events do the researchers experience in the R&D of rare diseases? (type of discovery)

RQ2: Which mechanism does prevail in the trigger of serendipity in the R&D of rare diseases?

RQ3: How does knowledge arbitrage contribute to serendipity?

Since the nature of inquiry in rare diseases is mainly 'target' (researchers concentrate on a specific disorder to discover a treatment), we focus only on Walpolian and Mertonian serendipity. All the mechanisms conducive to

serendipity (*theory-led*, *observed-led*, *error-born*, and *network-emergent)* were considered in our research framework (see Fig. 1).

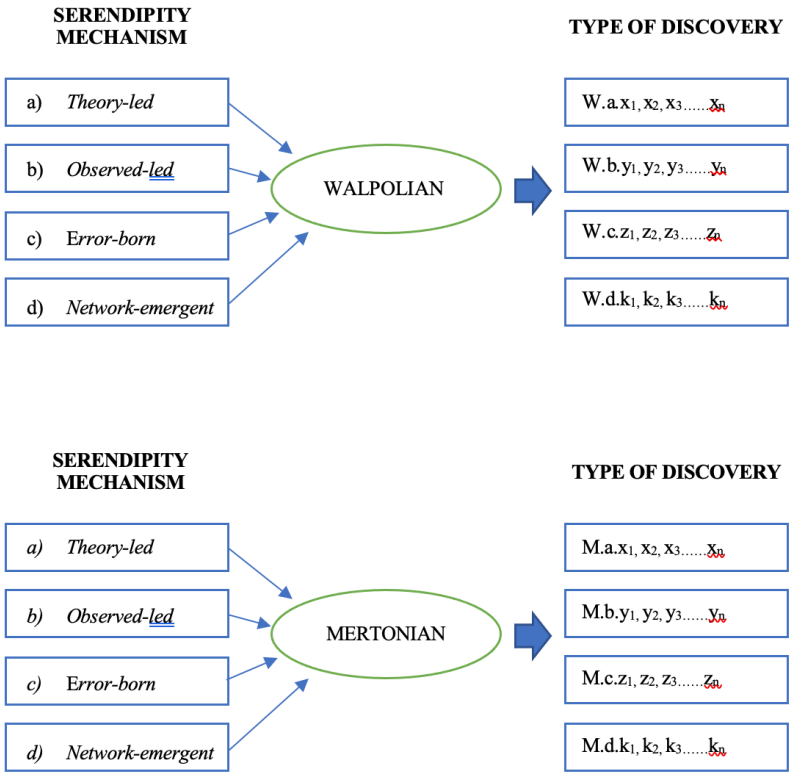

Figure 1 – Research Framework
Source: our elaboration

3 Methodology

This paper represents the first output of multiple-step research aiming to detect the profitability of the serendipitous discoveries arising from R&D in rare diseases. The overall research design follows Shorten and Smith (2017) and is based on an exploratory sequential. In this conference's contest, we mainly explain the first step of our investigation (qualitative data collection and analysis). Sample selection, procedure, and data analysis are detailed in the following subsections.

3.1 Sample

Tigem (Telethon Institute of Genetics and Medicine) was selected as an instrumental casework (Stake, 1994). Tigem is a Telethon Foundation organization founded in 1994 as a leading European research center. It is in Pozzuoli, Italy, with 230 staff members and 17 research groups.

Tigem is a multidisciplinary research institute exploring the mechanisms underlying rare genetic diseases. Its main aim is to discover how anomalous molecular mechanisms produce disease and develop innovative therapies. To achieve its aims, the institute conducts research projects along three main lines: cell biology, medical genomics, and molecular therapy. Tigem is supported by Telethon Foundation, which guides scientists in the processes needed to foster discoveries and turn them into valuable products and therapies. Notably, Telethon Foundation enables research partnerships with academia, industry, and potential investors.

The case study fits all the criteria Miles and Huberman (1994) suggested for the sample selection in qualitative research. Because of its core activity (R&D in rare diseases), Tigem is relevant to the conceptual framework and the research questions addressed by our investigation and will likely generate significant knowledge about the phenomena we wish to explore. Since we focus on the scientists' research activities, our case study allows us to comprehensively describe the serendipitous events and the mechanism leading to accidental discoveries. Finally, the sample plan is feasible regarding the accessibility of the research center and competencies (homogeneity between parties regarding linguistic and communication skills).

3.2 Data collection and procedure

In this study, we employed an instrumental casework selection (Stake, 1994). After collecting information about the activities held at Tigem, we contacted the head of the Molecular Therapy Program (one of the three main research lines in Tigem) to check the availability to participate in our investigation. The research group belonging to the program is currently developing novel therapeutic approaches for mitochondrial-associated disorders. After, confirmation, a first meeting was organized in Tigem Pozzuoli and an in-depth interview was managed to check whether and to what extent the Tigem scientists' activities could address our research goal. As Yin (2009) recommended, a research

protocol—including the interview and procedure guide—was planned before engaging in the research. The interview lasted about 60 minutes, was managed flexibly, and involved the exploration of the two macro-areas of investigation (serendipity and knowledge arbitrage). During data collection, we encouraged the informant to provide concrete examples to describe certain aspects of the Tigem activities and the R&D in rare diseases in more detail. After the interview, a shared research guide was detailed to be delivered (online) to the three main research groups actively working in Tigem.

Based on open-ended questions, the interview guide was developed following Ahmad (2018). Questions mainly focus on the respondents' research experience developed within the Tigem and the role of serendipitous events and knowledge arbitrage in the R&D. Participants were asked to provide examples about the experiences of serendipity and knowledge arbitrage, detailing the mechanisms driving the unexpected discoveries. A copy of the interview guide is available upon request.

After the first screening, face-to-face meetings were scheduled with the scientists who agreed to participate in the research.

The interviews were audio recorded, later transcribed, and checked for accuracy. We adopted a qualitative interpretive approach (Nag & Gioia, 2012; Gioia et al., 2013) to get a compelling account and explanation of what is observed. This approach helped us prevent the loss of information by coding the data corpus (informants' voices) as first-order codes before aggregating them to second-order themes (abstract concepts from the first-order categories) and finally identifying the aggregate dimensions (theoretical themes).

4 Some findings and future research directions

Given the complex nature of our exploration and the high number of interviews to be scheduled, the investigation is still running at the submission date. Consequently, the proposed findings should be considered provisional in any case.

Notably, the first in-depth interviews were held at the beginning of February 2023. Online survey distribution started on March 2023. Ten scientists agreed to be engaged in our research; thus, forwarding meetings were scheduled in line with each participant's availability.

Regarding the first research question, collected information confirms that serendipity is crucial in advancing research in rare diseases. Remarkably, one respondent reported:

> *"unexpected discoveries are crucial in the advancement of knowledge. There is no research without serendipity…every scientist in this institute has experienced a serendipitous event at least once in his carrier…we have many examples"*.

The respondents cited Walpolian and Mertonian serendipity, even if collected data are insufficient to determine the frequency of each event within the research process. Nevertheless, detecting the contribution of Walpolian serendipity to un-targeted problems (Ex.: fields others from rare diseases) could be helpful in tracking the discoveries, detailing their impacts and profitability. It means providing the potential stakeholders with new information to assess the expected return on their investments (the last being linked to related and unrelated business).

Relevant remarks also refer to both the mechanisms triggering the serendipity and the contribution of knowledge arbitrage (RQ2 and RQ3).

Alessia Indrieri, responsible for the mitochondrial lab, explained:

> *"One day, some years ago, I was having a break for a coffee together with my close friend Sabrina Carella. At that time, Sabrina worked within the research group led by Sandro Banfi in Tigem. During our break, Sabrina described how two RNA molecules affect the development of the retina. These two molecules (miR181 and miR181b) also play a role in mitochondrial activities. Thus, we asked ourselves if they could be what I was in search for… I discovered that miR181 and miR181b affect mitochondrial life, from their born to the disposal of those no longer need, and I found that unexpectedly while having a coffee…"*
>
> *"We patented a new molecule, inhibiting miR181 and miR181b. We put the molecule in an inactivated virus to transfer it inside human cells in a safe way. The results of the first experiments to treat the Leber hereditary optic neuropathy and dominant optic atrophy are promising"*.

The collected information confirms the relevance of networks in supporting knowledge share among the parties and triggering serendipity. In so doing, it provides suggestions on how collaboration may avoid 'echo chamber' and 'group-thinking'. Moreover, the example opens a more in-depth investigation of knowledge arbitrage and the difficulties in demarking boundaries between

network-led serendipity mechanisms and using knowledge from different sources. Since a *network-led* mechanism always implies the engagement of multiple people, knowledge arbitrage should be considered a *condictio sine qua no* to prompt serendipity.

More interesting to get our final goal is tracking the impact of the mentioned discovery on treating more common diseases due to mitochondrial dysfunctions, like Parkinson's. Considering the positive effects of the serendipity in rare diseases on the untarget markets is necessary to get a more truthful and accurate assessment of the potential return on investments of the stakeholders.

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Smart Waste Bins: Tackling Waste Management Challenges in Touristic Areas and the Hospitality Industry

Sergio Barile

Department of Management
Sapienza University of Rome

Aysel Alizada

Department of Management
Sapienza University of Rome

Paolo Barile

Department of Informatics
University of Salerno

* *Corresponding author*

Abstract

Waste management in touristic areas and the hospitality industry is a significant concern, with the problem exacerbated during large events. This research paper aims to explore the main problems of waste management in these sectors and propose the implementation of smart waste bins as a solution. The study includes an in-depth analysis of current waste management practices and the potential benefits and challenges associated with smart waste bins. We examine their effectiveness, cost-efficiency, and potential for integration with existing waste management infrastructure, as well as their potential environmental and social benefits.The results show that smart waste bins, when strategically deployed and integrated into a comprehensive waste management plan, can significantly improve waste management efficiency, reduce environmental impact, and support sustainable tourism and hospitality operations.

Keywords - sustainability, waste management, smart waste bins

Paper type – Academic Research Paper

1 Introduction

1.1 Background and problem statement

Waste management has emerged as a critical issue for touristic areas and hospitality industry, with these sectors being significant contributors to the generation of solid waste. The high volume of tourists, coupled with the nature of their activities, leads to the production of large amounts of waste, particularly during peak seasons and events. Proper waste management is essential not only for preserving the environment, but also for maintaining the attractiveness of these destinations and ensuring sustainable tourism and hospitality practices.

The challenges faced by the industry include inefficient waste collection and disposal systems, lack of waste segregation and recycling facilities, environmental pollution, and limited infrastructure and budget allocation for waste management. In response to these challenges, the implementation of innovative solutions, such as smart waste bins, is increasing particular attention. These intelligent systems aim to improve waste management efficiency, reduce environmental impact, and optimize resources.

1.2 Research objectives

The primary objectives of the research paper are to:

a) Identify and analyze the main problems of waste management in touristic areas and hospitality industry. b) Investigate the potential of smart waste bins as a solution for waste management during large events in these specific fields. c) Evaluate the advantages, challenges, and limitations of smart waste bins. d) Provide recommendations for the successful implementation of smart waste bins in touristic areas and hospitality industry.

1.3 Research scope and limitations

This study focuses on the application of smart waste bins as a waste management solution for touristic areas and hospitality industry, particularly during large events. The paper reviews the existing literature and case studies to understand the potential of smart waste bins and their role in addressing the identified waste management problems. The research is limited by the scarce availability of data on the implementation of smart waste bins in these specific

sectors and the potential bias in case study selection. Additionally, the findings of this study may not be universally applicable, as waste management challenges and solutions may vary depending on the local context and available resources.

2 Literature Review

2.1 Waste management evolution

The history of waste management dates back to ancient civilizations, where waste was typically disposed of in open pits or dumped into rivers or other bodies of water (Fytilis, N., & Poulakakis, N. (2017)). However, the development of cities and industrialization in the 18th century led to increased amounts of waste, and the need for more sophisticated waste management practices (Graham-Rowe, E. (2011)).

From 1750 to the mid-20th century, waste was primarily collected by hand and transported to disposal sites such as open dumps or landfills. The first modern landfill was established in 1937 in the United States, which marked a significant milestone in waste management (Yang, S. (2019)). In the 20th century, advances in technology led to the development of more efficient waste management practices, such as incineration and recycling. Incineration became popular in the 1950s and 1960s as a way to reduce the volume of waste, and it is still used today in some areas. Recycling also became more widespread in the latter half of the 20th century, and continues to be an important part of waste management (Tsai, Y. C., & Kang, Y. T. (2018)).

The development of the internet and digital technology in the late 20th century and early 21st century led to the emergence of smart waste management systems (Medina, M., & Bovea, M. D. (2013)). These systems use technology such as sensors, cameras, and artificial intelligence (AI) algorithms to optimize waste collection, sorting, and processing.

Artificial intelligence (AI) can play a significant role in improving waste management in smart cities (Sahoo, S., Ghosh, S. K., & Das, S. (2021)). By using advanced analytics and machine learning techniques, AI can help identify patterns and trends in waste generation and disposal, and provide valuable insights to city planners and waste management authorities (Gholami, R., Nabavi, S. M. B., & Esmaeili, M. (2019)). AI has, infact, the potential to transform waste management

in smart cities by optimizing the collection, transportation, and disposal of waste (Kothari, R., & Tariq, F. (2020)).

2.2 Waste management in touristic areas and hospitality industry

Touristic areas and hospitality industry face unique waste management challenges due to the seasonal and event-driven nature of their activities (Mensah, 2006). Waste generation tends to increase significantly during peak seasons and large events, which can strain existing waste management infrastructure (Khan et al., 2016). Moreover, the diverse range of waste materials generated in these sectors, including food, packaging, and hazardous waste, poses additional challenges for effective waste segregation and recycling (Sharpley, 2014).

The consequences of inadequate waste management in these sectors are manifold, including negative environmental impacts, damage to the local ecosystem, and decreased tourist satisfaction (Dodds et al., 2010). Sustainable waste management practices have, therefore, become increasingly important for preserving the environment and maintaining the long-term attractiveness of touristic areas and hospitality industry (Gössling et al., 2015).

2.3 Smart waste bins and their role in waste management

Smart waste bins are an emerging waste management solution that integrates Internet of Things (IoT) technology to optimize waste collection and disposal processes (Al-Masri et al., 2020). These bins are equipped with sensors that monitor waste levels, enabling real-time data collection and communication with waste management systems (Matta et al., 2018). By providing real-time data on waste levels, smart waste bins can help optimize waste collection schedules, reduce waste transportation costs, and improve overall waste management efficiency (Zorpas et al., 2020).

Additionally, smart waste bins can support waste segregation and recycling by providing separate compartments for different waste materials and offering visual and auditory cues to users for proper waste disposal (Bing et al., 2016). By promoting recycling and more efficient waste management practices, smart waste bins can contribute to environmental sustainability and reduce the negative impacts of waste in touristic areas and hospitality industry (de Lange et al., 2019).

2.4 Environmental impact of waste in touristic areas and hospitality industry

Waste generated in touristic areas and hospitality industry has significant environmental implications, including land and water pollution, greenhouse gas emissions, and depletion of natural resources (Cohen et al., 2014). In particular, improper disposal and management of waste can lead to soil and water contamination, posing risks to local ecosystems and human health (Andrades & Dimanche, 2017).

Furthermore, waste generation contributes to climate change through the release of greenhouse gases during waste decomposition and incineration processes (Bogner et al., 2007). As a result, sustainable waste management practices, such as the implementation of smart waste bins, are essential for mitigating the environmental impacts of waste in these sectors and supporting global efforts to combat climate change (Brouwer et al., 2017).

3 Methodology

This study employs a mixed-methods research design, which combines both qualitative and quantitative approaches to address the research questions. Our approach allows for a comprehensive understanding of the effectiveness of smart waste bins in addressing waste management challenges in touristic areas and hospitality industry during large events. The coming sections will focus on the methodology employed in this research paper, consisting of three primary components: data collection, data analysis, and evaluation criteria.

3.1 Data collection

1. In view of the mixed-method approach underlying the methodology of our study, data have been acquired from various sources: academic articles, reports, and books. A comprehensive literature review has been conducted to gather information on the waste management challenges in touristic areas and hospitality industry, environmental and social impacts of improper waste management, and the concept and technology of smart waste bins.
2. Case studies: two case studies have been selected to examine the implementation of smart waste bins in a touristic area and in the hospitality industry, during a large event. These case studies will

provide real-world examples of the application of smart waste bins and their effectiveness in addressing waste management challenges.

3. Government documents, industry reports, and news articles: these sources have been used to gather information on waste management policies, regulations, and practices in the study areas, as well as the costs and benefits of implementing smart waste bins.
4. Interviews and surveys: key stakeholders, such as waste management authorities, event organizers, and hospitality industry representatives, have been interviewed to gather insights into the challenges faced in waste management during large events and the implementation of smart waste bins. Surveys have also been conducted among event attendees and local residents to gather their perspectives on the effectiveness and benefits of smart waste bins.

3.2 Data analysis

The data analysis process involved a qualitative assessment of the collected literature to identify and categorize the main problems of waste management in touristic areas and hospitality industry. Further analysis focused on the potential application of smart waste bins as a solution to these problems, considering their advantages, challenges, and limitations. The assessment also includes a review of case studies where smart waste bins have been successfully implemented during large events. This analysis aims to provide insights into the feasibility and potential impact of smart waste bins in addressing waste management issues in the studied sectors.

3.3 Evaluation criteria

To evaluate the effectiveness of smart waste bins as a waste management solution for touristic areas and hospitality industry, the following criterias were considered:

a) Waste management efficiency: The ability of smart waste bins to optimize waste collection, transportation, and disposal processes, thereby improving overall waste management efficiency. b) Waste segregation and recycling: The potential of smart waste bins to promote waste segregation and recycling, contributing to waste reduction and resource recovery. c) Environmental impact:

The extent to which smart waste bins can mitigate the negative environmental effects of waste generated in touristic areas and hospitality industry. d) Cost and resource optimization: The potential of smart waste bins to reduce waste management costs and optimize the allocation of resources, such as labor and equipment. e) Implementation challenges: The identification and assessment of potential barriers to the successful implementation of smart waste bins in the studied sectors, including technological, financial, and logistical challenges.

The evaluation of these criteria, based on the data analysis, will inform the recommendations and conclusions of this research paper.

4 Main Problems of Waste Management in Touristic Areas and Hospitality Industry

Touristic areas and hospitality industry often struggle with ***inefficient waste collection and disposal systems,*** resulting in waste accumulation and improper disposal (Mensah, 2006). Inefficient systems can stem from a lack of proper planning and coordination among stakeholders, outdated waste management infrastructure, and inadequate investment in waste management technologies (Khan et al., 2016). ***Tourist influx*** during peak seasons and large events leads to a significant increase in waste generation, putting additional pressure on waste management systems (Sharpley, 2014). The temporary nature of some events complicates waste management, as event organizers may not prioritize sustainable waste practices or invest in long-term solutions (Dodds et al., 2010). ***Waste segregation and recycling are often limited*** in touristic areas and hospitality industry due to a lack of awareness among tourists and employees, insufficient recycling facilities, and inadequate policies and incentives to encourage recycling (Gössling et al., 2015). As a result, valuable resources are lost, and the environmental impact of waste is exacerbated (Cohen et al., 2014). Improper waste management in touristic areas and hospitality industry can lead to severe ***environmental pollution***, including land and water contamination (Andrades & Dimanche, 2017). The pollution not only harms local ecosystems, but also poses risks to human health and is negatively affecting the attractiveness of tourist destinations (Brouwer et al., 2017). In many touristic areas and hospitality industry, ***waste management infrastructure*** is inadequate due to limited financial resources and competing priorities (Matta et al., 2018). Budget constraints can hinder the development and maintenance of waste management

facilities, leading to suboptimal waste management practices and increased environmental impacts (Zorpas et al., 2020). Furthermore, a lack of coordination among stakeholders, including local authorities, businesses, and event organizers, leads to an exacerbation of all these challenges (de Lange et al., 2019).

5 Implementation of Smart Waste Bins

5.1 Overview of smart waste bins

Smart waste bins are innovative waste management solutions that leverage Internet of Things (IoT) technology to optimize waste collection, transportation, and disposal processes (Al-Masri et al., 2020). Equipped with sensors that monitor waste levels, smart waste bins provide real-time data on waste levels, enabling efficient waste collection scheduling and route planning (Matta et al., 2018).

5.2 Advantages of smart waste bins

Smart waste bins allow for real-time monitoring of waste levels, which helps optimize waste collection schedules and reduce waste transportation costs (Zorpas et al., 2020). This data-driven approach can also assist in identifying waste generation trends, allowing event organizers and local authorities to plan and allocate resources more effectively.

Smart waste bins can facilitate waste segregation and recycling by providing separate compartments for different waste materials and offering visual and auditory cues to users for proper waste disposal (Bing et al., 2016). By promoting recycling, smart waste bins contribute to waste reduction, resource recovery, and environmental sustainability.

The real-time data provided by smart waste bins enables waste collection services to focus on bins that are full or nearing capacity, thus preventing overflows and reducing the frequency of unnecessary collections (Matta et al., 2018). This efficiency can result in lower fuel consumption and reduced greenhouse gas emissions from waste transportation vehicles. By streamlining waste collection processes and promoting recycling, smart waste bins can help reduce waste management costs and optimize the use of resources such as labor and equipment (Zorpas et al., 2020).

5.3 Challenges and limitations of smart waste bins

The implementation of smart waste bins requires a significant initial investment in IoT technology, sensors, and related infrastructure (Al-Masri et al., 2020). Additionally, the maintenance of smart waste bins can be more costly than traditional bins due to the complexity of the technology. Integrating smart waste bins into existing waste management systems can be challenging, as it may require significant adjustments to waste collection routes, schedules, and procedures (Matta et al., 2018). The collection of real-time data by smart waste bins raises privacy and data security concerns, as improper handling of this information could potentially compromise users' privacy (de Lange et al., 2019).

5.4 Case studies

To demonstrate the effectiveness of smart waste bins in addressing waste management challenges in touristic areas and hospitality industry during large events, we present two case studies.

Case study 1: Implementation of smart waste bins in a touristic area

Location: A popular beach destination

Problem: During peak tourist season, the beach area faced issues such as overflowing waste bins, littering, and inadequate recycling, leading to environmental pollution and negative visitor experiences.

Solution: The local municipality implemented a network of smart waste bins along the beachfront and nearby commercial areas. The smart waste bins were equipped with sensors for real-time monitoring, separate compartments for waste segregation, and interactive elements to encourage proper waste disposal.

Results: After implementing smart waste bins, the following improvements were observed:

1. More efficient waste collection: The real-time monitoring data allowed the municipality to optimize waste collection schedules and routes, reducing fuel consumption and labor costs.
2. Increased recycling rates: The waste segregation features of the smart waste bins resulted in higher recycling rates and reduced waste sent to landfills.

3. Improved visitor experience: The cleaner beach environment and interactive elements of the smart waste bins contributed to a more positive visitor experience.

Case study 2: Deployment of smart waste bins during a large event in hospitality industry

Location: A music festival at a hotel resort

Problem: The large influx of attendees led to a significant increase in waste generation, creating waste management challenges such as overflowing bins, littering, and inadequate recycling.

Solution: The event organizers deployed a network of smart waste bins throughout the festival grounds. These bins featured real-time monitoring, waste segregation capabilities, and interactive elements to encourage proper waste disposal.

Results: The implementation of smart waste bins during the music festival led to the following outcomes:

1. Optimized waste collection: The real-time monitoring data enabled event organizers to efficiently schedule waste collection, reducing overflowing bins and associated littering.
2. Enhanced recycling efforts: The waste segregation features of the smart waste bins facilitated recycling and improved waste diversion rates.
3. Positive attendee experience: The cleaner festival environment and engaging features of the smart waste bins contributed to a more enjoyable experience for attendees.

These case studies demonstrate that the implementation of smart waste bins in touristic areas and during large events in hospitality industry can effectively address waste management challenges by optimizing waste collection, promoting recycling, and improving the overall visitor experience.

6 Discussion

6.1 Evaluating the feasibility of smart waste bins for touristic areas and hospitality industry

The feasibility of implementing smart waste bins in touristic areas and hospitality industry depends on various factors, such as the availability of financial resources, technological infrastructure, and stakeholder collaboration. While the

initial investment and maintenance costs can be significant, the potential benefits, including improved waste management efficiency, waste reduction, and environmental sustainability, can outweigh these expenses in the long run (Zorpas et al., 2020).

Successful integration of smart waste bins into existing waste management systems requires careful planning and collaboration among local authorities, businesses, and event organizers. This collaboration can help address potential challenges, such as adjusting waste collection schedules, routes, and procedures, while also ensuring that smart waste bins are used to their full potential (Matta et al., 2018).

6.2 Potential impact on waste management efficiency and environmental sustainability

When strategically deployed and integrated into a comprehensive waste management plan, smart waste bins can significantly improve waste management efficiency in touristic areas and hospitality industry. Real-time monitoring and data collection allow for better waste collection planning, reducing transportation costs, and preventing waste overflows (Al-Masri et al., 2020).

Moreover, by promoting waste segregation and recycling, smart waste bins can contribute to waste reduction and resource recovery, reducing the environmental impact of waste generated in these sectors (Bing et al., 2016). This can, in turn, help preserve local ecosystems, maintain the attractiveness of tourist destinations, and support sustainable tourism and hospitality operations.

6.3 Recommendations for successful implementation

To maximize the potential benefits of smart waste bins in touristic areas and hospitality industry, the following recommendations should be considered:

a) Develop a comprehensive waste management plan that incorporates smart waste bins as part of an integrated solution, addressing the unique challenges faced by touristic areas and hospitality industry. b) Establish public-private partnerships and collaborate with stakeholders, including local authorities, businesses, and event organizers, to secure funding, share expertise, and facilitate the implementation of smart waste bins. c) Invest in public awareness campaigns to educate tourists, event attendees, and employees about proper waste disposal,

recycling, and the use of smart waste bins. d) Address privacy and data security concerns by implementing robust data protection measures and ensuring transparency in data handling practices. e) Continuously monitor and evaluate the performance of smart waste bins to identify areas for improvement and ensure their long-term effectiveness in addressing waste management challenges.

By considering these recommendations, touristic areas and hospitality industry can successfully implement smart waste bins and benefit from their potential in improving waste management efficiency and promoting environmental sustainability.

7 Conclusion

Waste management in touristic areas and hospitality industry presents unique challenges, including inefficient waste collection and disposal systems, high waste generation during peak seasons and events, limited waste segregation and recycling, and environmental pollution. Addressing these challenges is crucial for maintaining the attractiveness of tourist destinations, preserving local ecosystems, and ensuring sustainable tourism and hospitality practices.

Smart waste bins offer a promising solution for improving waste management efficiency, promoting waste segregation and recycling, and mitigating the environmental impact of waste generated in these sectors. By leveraging IoT technology and real-time data, smart waste bins can optimize waste collection and transportation, reduce waste management costs, and contribute to environmental sustainability.

However, the successful implementation of smart waste bins in touristic areas and hospitality industry requires a comprehensive waste management plan, stakeholder collaboration, and public awareness campaigns. Additionally, addressing privacy and data security concerns is essential to ensure the responsible use of this technology.

In conclusion, while smart waste bins present a viable solution for addressing waste management challenges in touristic areas and hospitality industry, their successful implementation depends on careful planning, resource allocation, and collaboration among all stakeholders. By adopting a strategic and integrated approach, these sectors can harness the potential of smart waste bins to support sustainable waste management practices and contribute to a more environmentally responsible tourism and hospitality industry.

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Appendices

Appendix A: Technical Specifications of Smart Waste Bins

This appendix provides an overview of the technical specifications and features commonly found in smart waste bins:

1. Sensors: Various types of sensors can be used in smart waste bins, including ultrasonic, infrared, and weight-based sensors, to measure the fill levels of the bins.
2. Communication systems: Smart waste bins typically use wireless communication technologies such as IoT, GPS, or cellular networks to transmit data to a central control system.
3. Waste compartments: Some smart waste bins have separate compartments for different types of waste, such as organic, recyclable, and non-recyclable materials, to facilitate waste segregation and recycling.
4. Waste compactors: Some models of smart waste bins feature built-in waste compactors that compress the waste, increasing the overall capacity of the bin and reducing the frequency of waste collection.

5. Interactive elements: Smart waste bins may incorporate touchscreens, audiovisual feedback, or other interactive elements to engage users and encourage proper waste disposal behavior.
6. Power sources: Smart waste bins can be powered by various sources, including the electrical grid, solar panels, or batteries.

Appendix B: List of Case Studies and Sources

This appendix provides a list of case studies and sources used in this research paper:

1. Case study 1: Implementation of smart waste bins in a touristic area Source: [Reference to the relevant academic article, report, or news article]
2. Case study 2: Deployment of smart waste bins during a large event in hospitality industry Source: [Reference to the relevant academic article, report, or news article]

Appendix C: Interview and Survey Questions

This appendix includes sample interview and survey questions that can be used to gather insights from key stakeholders and the public:

3. How do you perceive the current waste management practices in touristic areas or during large events in hospitality industry?
4. What are the main challenges you face in managing waste during large events or in touristic areas?
5. Have you had any experience with smart waste bins? If so, how effective were they in addressing waste management challenges?
6. What benefits or drawbacks do you see in implementing smart waste bins in touristic areas or during large events in hospitality industry?
7. As a visitor or event attendee, how important is the cleanliness of the location, and how does it affect your overall experience?
8. How likely are you to engage with smart waste bins and follow proper waste disposal practices if they were available in touristic areas or during large events?

A Morpholgical Analysis of Large Scale Research Infrastructures

Roberto Linzalone*

Department of Mechanical, Energy and Management Engineering
University of Calabria
Via Pietro Bucci, 46/C, 87036 Rende (CS), Italy

Isabella Nocella

Department of Mechanical, Energy and Management Engineering
University of Calabria
Via Pietro Bucci, 46/C, 87036 Rende (CS), Italy

Salvatore Ammirato

Department of Mechanical, Energy and Management Engineering
University of Calabria
Via Pietro Bucci, 46/C, 87036 Rende (CS)Italy

Alberto Michele Felicetti

Department of Mechanical, Energy and Management Engineering
University of Calabria
Via Pietro Bucci, 46/C, 87036 Rende (CS), Italy

* *Corresponding author*

Abstract

Large Scale Research Infrastructures are rising in the competitive and globalized research environment, since they offer to external researchers-users, inputs and services for cutting-edge, large scale research. Such researches would not be possible with normal infrastructures and budgets of single Universities and Research institutions. However, despite the strategic relevance acknowledged to LSRI by the nascent literature and by national policymakers, there is a lack of comprehensive frameworks capturing both strategic dimensions and inherent options a LSRI may have. Given the infancy of this topic, and the empirical nature of the literature to date, a holistic framework on LSRI would increase the sense of existing studies and provide the ground for future advancement. This paper aims to bridge this gap, by identifying strategic *dimensions* and relative options, a Large Scale Research Infrastructure can assume.

The research is carried out adopting a mixed research methodology merging a literature review with a survey conducted on a sample of 11 LSRIs; they provided the dataset for the parametrization of a *Morphological Matrix*.
The research led to the identification of the strategic *dimensions* and the *solutions* (i.e. the spectrum of strategic *options)* defining the LSRI's morphology. These findings represent, on another side, the starting point for a future and hopeful Morphological Analysis of LSRIs.
This paper originally proposes the dataset needed to develop a morphological analysis of Large Scale Research Infrastructures.

Keywords – Research Infrastructure, Science platform, Large Scale Research Infrastructure, Research strategy.

Paper type – Academic Research Paper

1 Introduction

In a global and hypercompetitive geo-political context, national research strategies are becoming focal for the competitiveness of economic and industrial systems. Pushed by innovative managerial paradigms and supported by new technologies, the strategies of research are outlining emerging and rising models able to trade off large scale and lower budget, thus securing quality and impact of research. In this scenario, Large Scale Research Infrastructure is catalysing attention from both policymakers and Management scholars.

LSRIs are pivotal for several governments today, as confirmed by the share of research investments allocated by advanced countries (Florio and Sirtori, 2016; South Africa Ministry of Science and Technology, 2016). LSRI is one strategic objective of the European Commission, to promote international cooperation and integration, as well as to provide tools dedicated to the development of open science and to improve the performance of academic research (Fabre *et al.*, 2021).

Nonetheless, LSRI literature is lagging and lacking of strategic management understanding.

This paper aims to bridge this gap, analysing a fuzzy and embryonal topic, largely empirical according to current literature, by proposing a taxonomy and a characterization of LSRIs.

To come to an effective and insightful framing of existing research, we develop a General Morphological Analysis (GMA) (Zec and Matthes, 2018; Zwicky, 1967, 1969). The research question underpinning this study is then: what are dimensions and inherent positions a LSRI has? The answer to this question allows

to frame the field of existence of LSRI, and provide the basis for a characterization. We attempt to answer this question by crossing a critical literature review on LSRI and a survey conducted on a sample of 12 LSRIs.

The paper is structured as follows. In the first section, the dual approach to making science (*Big* vs. *Small*) is discussed, and the relevance of *research infrastructures* is highlighted with regard to Big science. The second section deepens the strategies of Science, discussing the *platformization* as a relevant and effective way to face risks, results and investments in the current global and competitive political scenario. The third section, then, put under the lenses the LSRI a specific model of research platform, who is finding the rising interest of policymakers and strategic management scholars. In section four the LSRIs are analysed and common dimensions of analysis are detected; the full range of options any LSRI can have is also explored. It reports the parametrization of the *Zwicky space* resulting from the literature analysis. Finally, section five discusses the findings, the limitations and the future developments of the research.

2 Conceptual Background

2.1 Science, Research and Research Infrastructures

Science is advancing at higher pace and volume as never seen before. As witnessed by scientific publications - any scientific or engineering article published in the fields of physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, earth and space sciences - research has increased regularly over the past 20 years, reaching the count of 2.5 mln. in 2018 (WorldBank, 2018). Just to stress the expanding stage of research, both geographically and numerically, the number of publications per year has doubled in only 15 years, from 2003 to 2018 (WorldBank, 2018).

The huge growth of science in a more competitive and constrained environment is awaking reflections on the efficiency and effectiveness of the research models: how to cope with the need of larger researches and smaller budgets?

If we look at the past, disruptive theoretical findings were obtained with almost no infrastructures, while incremental theoretical improvements achieved with large research teams and infrastructures (Wu *et al.*, 2019). Let us consider Einstein's results (1905): six researches of great impact in three different fields of

physics in few days, alone. Besides, in a few weeks he demonstrated the existence of atoms, theorized the existence of photons and the wave-particle dualism. He also demonstrated the equivalence between energy and matter, showing the (likely) most relevant research result of modern science: $E = mc^2$.

This case highlights the nature of *Small Science* (i.e. small research teams, almost no research infrastructures, driven by creativity, disruptive discoveries), opposed to that of *Big Science* (i.e. large, interorganizational research teams, large scale research infrastructures, driven by methodological and instrumental rigour, incremental discoveries).

Big Science produces results that are much cited but, in general, not very innovative (Wu *et al.*, 2019) and with lower societal, direct impact. As per (Kuhn, 1962) Big Science just do 'normal science'.

The scientific discoveries that require a "change of glasses" and even the abandonment of established paradigms are correlated with small research teams and infrastructures (Wu *et al.*, 2019). However, no Small science could have proved the Higgs boson, or sent a probe to the far side of the moon, considering the large scale of teams, infrastructures and funds. Both Small and Big Science are necessary and reinforcing. In addition, the more research obtains results, the more the relationship between Small Science and Big Science is closely interrelated. Today, in a global and competitive scenario, large research teams and infrastructures would support adequately any research.

Research infrastructure subtends both the physical and the virtual dimension of the research assets, whose importance is rising in recent years, due to the digital technologies. They are creating an unprecedented change and shaping the research process. The relevance of such changes are interesting both theoretically and practically, with regard to National research strategies and for the Local Development.

The role of Research Infrastructures (RI) is recently under the lenses of Management scholars, and of Universities and policymakers, since the higher, global research challenges require larger research infrastructures able to provide researchers with innovative technology and then produce competitive research. However, the ways to best exploit the RIs are underexplored to date.

A fundamental role in the scientific research process is played by the *research infrastructure,* the set of major equipment, instruments, services, knowledge-related facilities (e.g. collections, archives or scientific data infrastructures) databases, the researchers use (Toom and Miller, 2017). So they are facilities,

resources and related services (ESFRI, 2020). Due to technological innovation (e.g. artificial intelligence, computing, big data, social media, and others) infrastructure is gaining strategic relevance in research. The results they obtain, and the capacity to foster innovation, depend largely by the quality (e.g. reliability, innovativeness), the scale, the scope, the governance, the surrounding ecosystem, the RI has.

The national strategies in research are also addressing the infrastructure as a dimension able to support cross-institutional and cross-national networks, to contribute to the science advancement.

Infrastructure is different from *facility*. The use of Facilities (instruments, collections, data banks, laboratories) is commonplace as an indispensable support, but only in some cases these facilities are built and managed to provide service to external users (not belonging or funded by the owner institution or even coming from other countries). Many Facilities (sometimes also very expensive) are built, funded and managed mainly for the specific use of their owners (institutions, universities, industry). They have only marginal use for external researchers but their impact is relatively limited in terms of outreach and international visibility, on the contrary a RI is mainly designed, built and managed for external users/researchers (then those belonging to the owner).

Actually, Universities within their third-mission activities (Laredo, 2007; Vesperi and Gagnidze, 2019) put at disposal of both internal and external demand (e.g. private companies, public institutions, and other research centres) their research infrastructures, with regard to those located in Laboratories (Linzalone *et al.*, 2020). The use and the funding for that is regulated by contracts.

Research infrastructures can be both physical and electronic (e-infrastructures) (Toom and Miller, 2017). On a different perspective RIs are used as inputs to, or as underlying foundations for, scholarly research phases**:** conceptualization/funding, data collection, experimentation/analysis, publication, dissemination/out-reach, impact assessment (da Silva Neto and Chiarini, 2023). RIs include data sets, software packages, computational models, observational platforms, and computing facilities (Mayernik *et al.*, 2017)

The *European Strategy Forum on Research Infrastructures* highlights that RIs are used to conduct top-level research in their respective fields and covers major scientific equipment; knowledge-based resources such as collections, archives or structures for scientific information; enabling Information and Communications Technology-based infrastructures such as Grid, computing, software and

communication, or any other entity of a unique nature essential to achieve excellence in research (ESFRI, 2020).

Many research facilities are available to industry entrepreneurs, engineers, other researchers, and research institutions to carry out researches or technology developments (Toom and Miller, 2017).

Research facilities can be observatories, laboratories (including rooms and machines, devices, gears, mechanisms, etc.). While e-Infrastructures can be research databases including open data infrastructures and digital archives, research networks, software and service infrastructures (platforms of supercomputing facilities, research analysis software platforms for processing and analyzing data) (Toom and Miller, 2017).

2.2 The Platformization of research and the LSRIs

The extraordinarily fast scientific development of the vaccine for COVID-19 pandemic in about one year and a half, given that historically it takes about 17 years for research to translate from bench to bedside, is principally due to research infrastructures (Zakaria *et al.*, 2021). Unlike the traditional sequential development of research activities, multiple strands of activities were undertaken contemporary and supported by underlying research infrastructures (RI) or "platforms" (Zakaria *et al.*, 2021).

Economic hardships and strategic emergence of research infrastructures, pressure governments to review and scrutinize research allocation. Pioneer studies and researches support the importance of RI investment and aware against short-termism in resource allocation.

Thus, the concept of research infrastructure is rising in Strategic Management studies, since it can become the convenient dimension in which to allocate the *platform* model.

In today's networked age, strategic benefits are increasingly generated over platforms, which allow various actors to engage with one another (Fehrer et al., 2018). Platform paradigm is influencing and shaping research as many other domains. An increasing number of mature incumbent organizations, like Universities or National Research Institutes, are in environments in which they need either to operate as a platform provider or integrate into a business ecosystem governed by platforms (Altman, 2015).

The platform concept is emerging as an effective organizational model able to integrate a variety of (research) actors, around a basic and strategic asset, like the LSRI. It is not new with regard to scientific research. The *platformization of science* is running over any dimension and across many phases of research, up to the whole research life cycle (da Silva Neto and Chiarini, 2023).

(Mirowski, 2018) provided a "landscape of science platforms", crossing phases of scientific activities (getting started; preparatory; research protocols; writeup; publication; and post-publication) with users (normal scientist; funders; competing scientist; spectator scientist; outsider citizens; and, kibitzer), illustrating with some representative platforms.

Moreover, specific categories of research platforms have consolidated themselves as infrastructures, while certain scientific infrastructures have been platformed (da Silva Neto and Chiarini, 2023). The intertwine of the concepts *platform* and *infrastructure* is strategic and capable of great exploitation in a competitive scenario rewarding global, cutting-edge research.

The complex contributions played by different parts of the research system may be better described by progressing the current research evaluation model from one characterized by a "pipeline" to one better described as a "platform".

The concept of platform is coherent to analyse the large scale research infrastructures, in a scientific landscape that requires larger researches and higher efficiency at the same time.

Platform outputs are than families of research outcomes, sharing a common infrastructural base.

(Plantin *et al.*, 2018) explored the "landscape of science platforms", crossing phases of scientific activities (getting started; preparatory; research protocols; writeup; publication; and post-publication) with users (normal scientist; funders; competing scientist; spectator scientist; outsider citizens; and, kibitzer), illustrating with some representative platforms.

2.3 Large Scale Research Infrastructure. A Strategic Management review

Big Science is driven by the scale, economic and/or structural, of research infrastructures (such as large particle accelerators, space research, the Human Genome Project).

LSRIs are enablers of research in almost all scientific domains and represent an increasingly large share of research investment. RI is an organisational structure

dedicated to facilitate or conduct research, provide scientific equipment, data or services for use in basic or applied research (OECD, 2019). LSRIs are long-term enterprises, often operating for several decades. Research infrastructures (RI) are facilities, resources, systems, and services needed by scientific communities to carry out large-scale research in cutting-edge fields (Fabre *et al.*, 2021). The European MERIL project defines RI as a "facility or (virtual) platform that provides the scientific community with resources and services to conduct research in their respective fields. These research infrastructures can be single-sited, distributed or virtual (e-infrastructure), and can be part of a national or international network of facilities, or of interconnected scientific instrument networks" (Beckers, Jägerhorn, & Höllrigl, 2012). Examples of RI are astronomical observatories, particle accelerators, synchrotrons, lasers, and intensive computing resources, as well as data production and management tools. These infrastructures are used by researchers from all disciplines, in astronomy, biology, physics, chemistry, human and social sciences, earth sciences, etc., who have access to high-performance equipment in a high-level scientific environment.

> *"Over the past decades, Large Scale Research Infrastructures (LSRIs) have come to play a central role in providing scientist-users access to highly specialised scientific instrumentation and experimental conditions. Collaborations between (permanent) instrument scientists and users are at the core of these organisations, yet knowledge about the nature of such collaborations and their development over time is surprisingly scarce" (D'ippolito and Rüling, 2019).*

LSRIs are large-scale research facilities that require large investments and complex engineering and networking efforts; these infrastructures are usually primarily funded by national governments, shared by communities of scientists, and most often involve scientists permanently based at these facilities as well as external scientist-users (D'ippolito and Rüling, 2019).

LSRIs are large scientific instrumentation, facility, and equipment clusters that require large investments and complex engineering and networking efforts; they are usually recipients of funding by national or supranational bodies and shared by communities of scientists (D'ippolito and Rüling, 2019; Qiao et al., 2016).

A useful model elaborated by the (South Africa Ministry of Science and Technology, 2016) distinguishes the research infrastructures into: small equipment, departmental equipment, medium-sized infrastructures, and LSRIs. Roughly, they require from 0.5 mln € of investment up to 500 mln €. The range of

scientific equipment and infrastructure considered for the research infrastructure roadmap. SARIR focuses on RIs used for the whole scientific community in South Africa or, in some cases, with the participation of South Africa in other international RI. Some equipment in education or research institution departments may be included when it constitutes a component of a distributed RI and is coordinated with other infrastructures available in other nodes of the network to offer a global service to the scientific community. For reasons of comparison, Figure 1 also depicts the span of infrastructures

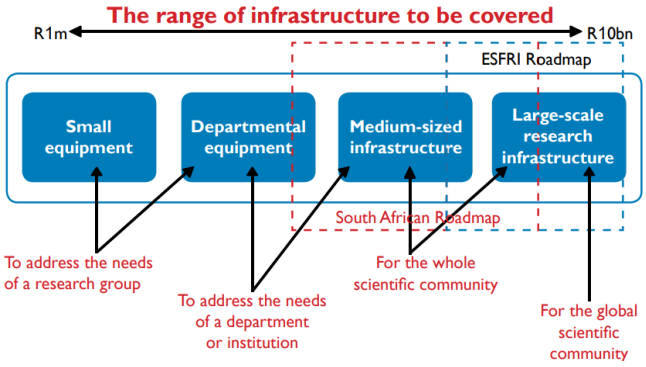

Fig. 1 - Objectives and financial scale (in RSA's rand) of Research infrastructures (South Africa Ministry of Science and Technology, 2016)

Most of the LSRIs are large experimental platforms, including, for example, synchrotron radiation sources, neutron sources, or advanced laser facilities, which serve both fundamental and applied research in a wide range of scientific disciplines (Qiao *et al.*, 2016).

The purpose of *experimental platforms* consists primarily in providing scientist-users access to highly specialised scientific instrumentation and experimental conditions beyond the reach of most university organisations. In areas such as neutron scattering, synchrotron radiation, and free electron lasers facilities, experimental platforms require intense collaboration between permanent scientists and external users, which is essential to produce science (Hackett et al., 2004; Hallonsten, 2016), and facilities need to be highly specialised while remaining attractive to broad scientific communities (Heidler and Hallonsten, 2015).

LSRIs are suitable in the current global and competitive scenario that require international research teams, cutting-edge research results. Scientific collaborations have always spanned organisational borders, but today globalization imposes it; the complex challenges posed by the society to science, make research questions too broad to be tackled by a single laboratory and require cross-discipline and cross-border cooperation.

Despite their value LSRI comes up as a challenge for Policy Makers and Universities, since the evaluation of financial and economic returns of LSRI investment is hard to account because of the many non-financial returns, over those strictly monetary (Novikova, 2022).

Uncertainty on the definition of the actual value, and of the returns of a LSRI investment affect decisions and strategies of research. Besides, LSRI projects are partly public and private, thus making inadequate both Cost Benefit Analysis and Financial Investments as evaluation approaches. This poses an interesting challenge to management scholarship regarding the public-private partnership (Beisheim *et al.*, 2014; El-Gohary *et al.*, 2006; Elia *et al.*, 2017) model suited to participate and fund the LSRI.

Given the large economic investments and the multidimensional types of returns, LSRIs poses some relevant questions to Management. LSRI is a way of doing research based on large groups and/or large research infrastructures. This means that the result must be reasonably certain, otherwise, great resources are wasted (or, at least, they are thought to be wasted). Also, the results and returns have various forms both financial and not, difficult to account.

Financial efficiency is the rate of return of LSRI as 'investment', while economic efficiency is the return performance including the all the other various forms of return (e.g. social, environmental, scientific) (Novikova, 2022).

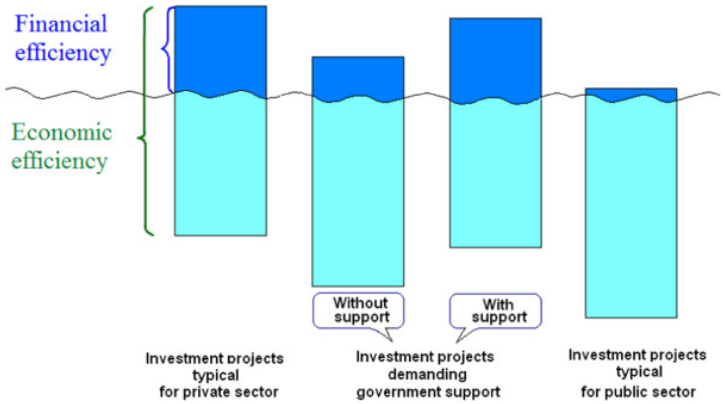

Fig. 2 – Financial and Economic efficiency of RIs, depending on the type of owner (Novikova, 2022)

Projects of the third group cannot attract ordinary private investors without any special support. Due to GS, financial efficiency increases to a level acceptable to private participants. Thus, government intervention solves the gap in financial and economic efficiency. The government uses the whole system of support tools, including various tax advantages and exemptions, tax expenditures, subventions, government guarantees, budget loans with lower interest rates, investments in equity, infrastructure facilities construction and other types of Public-Private Partnership contracts (Delmon, 2017). Thus, the government and the development institution play an essential role for specific participants, which can influence financial efficiency and bring it into line with the economic efficiency of this project.

RIs have a societal value and their impacts are not limited to fostering scientific knowledge for the benefit of scientists; they also impact their environment socially and economically (OECD, 2019). Their conception, construction and operation can involve and require unique technological developments, data management systems and highly-skilled staff. RIs offer opportunities for innovation and market development, can attract investments and contribute broadly to socio-economic development. In some cases, they can constitute a focal point for the development of an innovation ecosystem.

RIs are **largely funded** by public resources and their socio-economic impact is difficult to assess using conventional methodologies. Besides, RIs are extremely diverse, and can have a very broad range of direct and indirect impacts, which vary along the life cycle of the RI.

At the very least, information and communication technologies and data management services will be a fundamental part of every type of research infrastructure, but the construction phase of a new RI could also require the development and testing of new materials, the robotic manipulation of scientific instruments in hazard environments, or the deployment of a distributed network of specialised sensors in a wide range of RIs (South Africa Ministry of Science and Technology, 2016).

Linked with the economic effects of a LSRI, is the issue about the dimensions (Florio & Sirtori, 2016; D'Ippolito & Roling, 2019). Experts identify technological effects (Griniece, Reid, & Angelis, 2015; Reference, 2019; Reid, 2021), as well as knowledge spillovers (Ramadani, Abazi-Alili, Dana, Rexhepi, & Ibraimi, 2017; Tsyplakova, 2010; Li, 2002) among the most significant specific effects of LSRI projects (Prettner & Werner, 2016; Saler & Martin, 2001). Their study was carried out in the last century as part of a study of diffusion of innovations and related spinoffs (Llerna, Matt, & Trenti, 2011), indirect and external effects (Llerna et al, 2011; Lucking, Bloom, & Van Reen, 2018). Nevertheless, for LSRIs there are serious obstacles to success, since their most important results are not taken into account in the traditional methods of financial evaluation.

Literature highlights the '**social practice'** of RI's, as a core enabler**.** and Drawing from this, we proceed from an understanding of research infrastructures as deeply relational and adaptive systems where the material and social aspects are in permanent interplay. They are embedded in the social practice of research and influenced by environmental factors (Fecher *et al.*, 2021).

To date, many policies tend to focus on getting the technical aspect of research infrastructures off the ground, such as the development of major scientific equipment, sets of archival or scientific data, or communication and computing networks (Fecher *et al.*, 2021). Nonetheless, scholars in this field largely agree that only when a technical service is embedded in practice, when it becomes 'invisible' (Star and Ruhleder 1996; Bowker and Star 1999), can it be considered part of an infrastructure. In this understanding, infrastructures are much more than the technical assemblage of things; only when these are part of practice, can they be considered part of the infrastructure (Fecher *et al.*, 2021).

The nuances and complexity of a "platform" model, where utilization of expertise and facilities, delivery of team science, and fostering of innovation translates into benefits for the population, is not typically addressed through any of the tools and methods mentioned in the literature (Zakaria *et al.*, 2021)

Large Scale RI are long-term infrastructural investments, that makes existent evaluation research impact assessments unrealistic due to the timescales of current methods, too short (Zakaria *et al.*, 2021). Traditional criteria for assessing the impact of LSRI are not fit for purpose.

Thus RI finds a challenge with regard to evaluation of the impacts: if the use of linear or logic models (and their derivatives) is agreed for research projects and programmes, they are less applicable to LSRIs as they provide the platform from which the projects and programmes are delivered.

All in all LSRIs are rising for the advanced of scientific research (ESFRI, 2010); in particular they are central in research, education and innovation through their key role in advancing and dissemination of knowledge and technology (Beck and Charitos, 2021; Marcon and Ribeiro, 2021). They also contribute increase efficiency in the science-making. In particular, since science making is increasingly multidisciplinary, LSRIs help researchers to integrate and give answer for very complex scientific and social problems.

2.4 A Taxonomy of LSRI

Research infrastructures are facilities, resources, systems, and services needed by scientific communities to carry out large-scale research in cutting-edge fields (Fabre et al., 2021). The European MERIL project defines RI as a "facility or (virtual) platform that provides the scientific community with resources and services to conduct research in their respective fields. These research infrastructures can be single-sited, distributed or an e-infrastructure, and can be part of a national or international network of facilities, or of interconnected scientific instrument networks" (Beckers, Jägerhorn, & Höllrigl, 2012).

Typical RIs are astronomical observatories, particle accelerators, synchrotrons, lasers, and intensive computing resources, as well as data production and management tools. These infrastructures are used by researchers from all disciplines, in astronomy, biology, physics, chemistry, human and social sciences, earth sciences, etc., who thus have access to high-performance equipment in a high-level scientific environment.

By reviewing current literature, the following key dimensions can be identified.

1. **Location** (ESFRI, 2020; South Africa Ministry of Science and Technology, 2016) firstly identify the *location*.

a. **Single-sited** global facilities are unique, geographically localised facilities where governance is fundamentally international in character. The Large Hadron Collider at CERN and the International Thermonuclear Experimental Reactor are current examples.
b. Globally **distributed** research infrastructures constitute national or institutional nodes, which are part of a global network, and where governance is fundamentally international in character. For example, LifeWatch, the e-Science European Infrastructure for Biodiversity and Ecosystem Research, can only function through a globally coordinated set of nodes; Argo, a system for observing temperature, salinity, and currents in the Earth's oceans, and the Global.
c. E-infrastructure
d. National facilities of global interest are national facilities with unique capabilities that attract wide interest from researchers outside of the host nation. Antarctic or ocean drilling facilities are typical examples. The MeerKAT radio telescope in South Africa could be another example, since it will remain a globally important South African research instrument for several years prior to its amalgamation with the SKA. Existing RIs with the potential for wide international utilisation (for instance, facilities that leverage geographical advantages or exhibit unique opportunities for advanced research) may fall in this category. (South Africa Ministry of Science and Technology, 2016)
e. Mobile

2. **Function** (Qiao *et al.*, 2016) dissect RIs into the following three types according to their functions:
    a. dedicated research infrastructure
    b. public experimental platform
    c. public infrastructure
3. **Scientific effect** (Qiao *et al.*, 2016)
    a. science and technology advancement
    b. capability cultivation
    c. networking

d. clustering
e. knowledge spillover

4. Scientific domain (South Africa Ministry of Science and Technology, 2016):
   a. Humans and society;
   b. Health, biological and food security;
   c. Earth and environment;
   d. Materials and manufacturing;
   e. Energy.

5. Types of RI may (Mayernik *et al.*, 2017):
   a. Telecope
   b. Particle accelerator
   c. Synchrotron
   d. Laser
   e. Intensive computing
   f. Imaging
   g. Biobanking
   h. Big Data/ Data Mining
   i. Other

3 Research Methodology

The aim of this paper is to develop a taxonomy of LSRIs by the mean of a General Morphological Analysis (GMA) (Ritchey, 2018; Zwicky, 1967, 1969). GMA consists in the analysis by decomposition of a problem, through iterative cycles, to create a shared morphological model (Ritchey, 2018; Zec and Matthes, 2018). The problem is decomposed into key *parameters*, then possible *values* for each parameter are generated. The parameters and associated values define the *formal solution space* and are represented in the so-called *Zwicky Box* (i.e. a morphological field or *morphospace*) (Zec and Matthes, 2018). All the solutions to the initial problem can, then, be generated by combining the different partial solutions. In practice, many configurations are not viable for various reasons (e.g. logical or physical constraints).

This way the GMA will allow to dissect the parameters and values of LSRIs, and provide the basis for a comprehensive characterization.

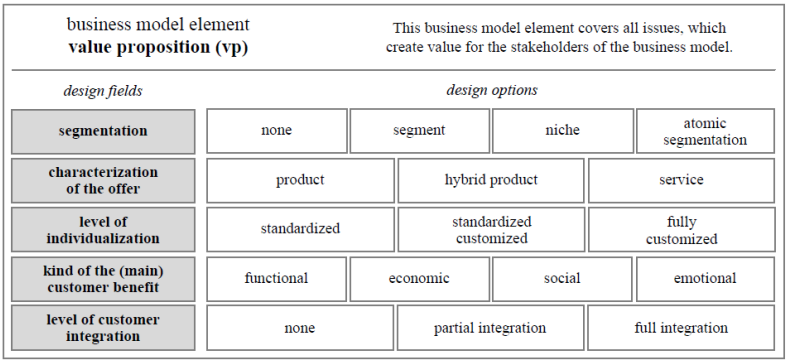

Fig. 3 - Example of the Morphospace applied to 'Business model elements' (Seidenstricker et al., 2014)

To take viability into account and reduce the combinatorial explosion, GMA software features pairwise *cross-consistency assessment* of parameter values for the semi-automated synthesis and interactive visualizations of the solution space (Ritchey, 2018). Dedicated software are then useful to provide such analysis.

3.1 Survey

To integrate the data emerged from the literature review we carried out a survey including a sample of selected LSRIs. The survey allowed to contextually triangulate, corroborate or refine the literature data, through an iteratiove process of definition and refinement of the *values* and *dimensions* of LSRIs.

Tab. 1 – Surveyed LSRIs

LSRI name	Location (Country)	Topic	Web Address
Elettra Sincrotrone Trieste	Trieste (Italy)	Synchrotrons and Fels	https://www.elettra.eu/it/index.html
European Synchrotron Radiation Facility (ESRF)	Grenoble (France)	Synchrotrons and Fels	https://www.esrf.fr/home.html
Diamond Light Source	Oxfordshire (UK)	Synchrotrons and Fels	https://www.diamond.ac.uk/Home.html
European Brain ReseArch INfrastructureS (EBRAINS)	Brussels (Belgium), Geneva (Switzerland) Swiss Branch	Computer and Data Infrastructure	https://ebrains.eu/
Metrology in Food and Nutrition (METROFOOD-RI)	Rome (Italy) Coordination Office	Food and Nutrition	https://www.metrofood.eu/

LifeWatch ERIC	Sevilla (Spain)	Ecosistem, structure and function	https://www.lifewatch.eu/
Microbial Resource Research Infrastructure (MIRRI)	Braga (Portugal) Registered Office	Biorepositories and Microorganism	https://www.mirri.org/
ECCSEL ERIC	Trondheim (Norway) Central Coordinating Office	Efficient Energy Conversion and Use	https://www.eccsel.org/
Partnership for Advanced Computing in Europe (PRACE)	Brussels (Belgium) Registered Office	Computing Infrastructure	https://prace-ri.eu/
Extreme Light Infrastracture (ELI)	Dolní Břežany (Czech Republic) Statuatory seat	Lepthon and Photon Beams	https://eli-laser.eu/
European RI on Highly Pathogenic Agents (ERINHA)	Brussels (Belgium) Registered Office	Biomedical Sciences and Research	https://www.erinha.eu/

4 Results

By combining qualitative data coming from both types of sources, literature and LSRI's websites, we were able to organize a Morphological Matrix for LSRIs.

Dimensions	**Characteristics**									
LOCATION	**Single Sited**		**Distributed**		**E-Infrastructure**				**Mobile**	
FUNCTION	**Dedicated**			**Public experimental platform**				**Public infrastructure**		
EFFECT	**Science and technology advancement**		**Capability cultivation**		**Networking effect**		**Clustering**		**Knowledge spillover**	
DOMAIN	**Humans and society**		**Health, biological and food security**		**Earth and environment**			**Materials and manufacturing**		**Energy**
SECTOR	**Food**	**Sea**	**Health**	**Society**	**Culture**	**Environment**	**Energy**	**Science**	**Engineering**	**Digital**
TYPE	**Telecope**	**Particle accelerator**	**Synchrotron**	**Laser**	**Intensive computing**	**Imaging**	**Biobanking**	**Big Data/ Data Mining**		**Other**
SCOPE	**National**			**International**			**Global**			
INVESTMENT	**Private**		**PPP without Suppprt**			**PPP with Support**			**Public**	
REVENUE	**Companies**		**Industrial Users**	**Consumer/Citizen Association**		**Industry R&D Dep.**	**Control Agencies**	**Public Labs**	**Private Labs**	

Fig. 4- Large Scale Research Infrastructure. Morphological Matrix

5 Conclusions

Despite the strategic role of LSRIs for future research policies, literature on LSRIs is in an embryonal state. Some studies address the issue regarding the evaluation of the investment (Novikova, 2022), some other the definitorial aspects (Fabre *et al.*, 2021), other the strategic aspects (South Africa Ministry of Science and Technology, 2016; Toom and Miller, 2017) however from a political standpoint.

With this research we attempted to focus strategic management elements of LSRIs, by developing a unitary framework able to tie together the key dimensions and values of LSRIs. To this aim we identified the General Morphological Analysis (Zwicky, 1967, 1969) as a powerful model, and combining a literature review and a survey on a sample of LSRIs we come to a tentative *Morphological space*. This result is limited by the consistency and representativeness of the sample, by the literature review, which is not structured and does not rely on a solid base given the infancy of the literature stream.

This paper's results, however, provide the basis and the direction for a full application and analysis of the GMA for LSRIs, that will fulfil an open question for both scholarship and policymakers.

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Entrepreneurship in a "Made in Italy" Company: Analysis of the Start-Up Phase

Salvatore Ferri

Department of Law and Economics of Production Activities
Sapienza University, Rome, Italy
Via del Castro Laurenziano 9, Rome

Carla Morrone

Department of Law and Economics of Production Activities
Sapienza University, Rome, Italy
Via del Castro Laurenziano 9, Rome

Riccardo Savio

Department of Law and Economics of Production Activities
Sapienza University, Rome, Italy
Via del Castro Laurenziano 9, Rome

Marco Ammaturo*

Department of Law and Economics of Production Activities
Sapienza University, Rome, Italy
Via del Castro Laurenziano 9, Rome

** Corresponding author*

Abstract

The objective of this article is to present the analysis of a case study regarding a small-medium enterprise Italian-owned company in the start-up phase, which produces consumer goods such as playful learning products for 0-24 months children. The Company is unlisted and is fully held by a family-controlled group. It meets the basic requirements of a 'Made in Italy' brand and its products are manufactured using production processes that reflect the concept of sustainability. The term 'sustainability' of a company refers to an organisation's concrete commitment to promoting a business model that not only enables the company's long-term profitability, but is also attentive to the environment, social welfare and long-term governance. The research is conducted through a qualitative method and intends to analyse implemented processes and results of the case study, obtained interviewing Company's management. In particular, the research focuses on

commercial, financial, and social strategies. The Company was founded in 2020 and, after establishing itself in the Italian market, it started a process of internationalisation, promoting itself as a 'Made in Italy' company.

Keywords – Entrepreneurship, Sustainability, Made in Italy.

Paper type – Academic Research Paper

1 Introduction

The evolution of Italian industrial organisation since the 1990s coincides with the formation of a further phase of Italian capitalism involving an increase in company size (Colli, 2005). It should be emphasised that most of the firms do not grow internally, but mainly externally (Tattara, 2006), moving from a simple to a more complex legal structure: corporate groups. This is linked to the considerable fixed costs required to use new technologies.

In those years, the development of medium-sized enterprises have place. These business have not only production but also logistical, commercial and financial competences, and work as the links between the final purchaser and the numerous small production units at certain stages of the process. Some of them achieve niche positions in the made-in-Italy sector and are able to invest in innovations to remain competitive, making in-house expertise increasingly exclusive and unique (Martucci and Rinaldi, 2012). They establish relationships with specialised suppliers by integrating the sector upstream, mainly within the same local production system or with other Italian entities, rarely with foreign companies (Gagliardi, 2006). Many companies, especially those that target foreign markets and have managed to improve their marketing networks, have established themselves among medium-high-end customers who appreciate the details and high quality of the product.

In light of the above, the transition from small to medium-sized enterprises improves the production efficiency of the entire system and increases its competitiveness when it is able to combine polyarchic and hierarchical systems (Arrighetti and Traù, 2007). In addition, product innovation stems from the demand for good characteristics and enables the company to improve profitability. Enterprises are induced to innovate not only by the pressing demand and the structure of the market in which they operate, but also by the skills they possess, which are the intangible elements to obtain positive effects from the

adoption of an innovation (Antonelli, 2001). Many companies that manage to arrive at the development of high technical, process and intellectual capabilities developed for the specific production of certain products in some markets manage to apply them in production chains that are completely different from the main product.

As known, firms are an open and interactive systems (Bertini, 1990) that continuously exchange with the outside, maintaining a network of connections with other players in the economic and social world. Indeed, company is the target and object of expectations and demands, the hub of a complex network of material, informational, and financial flows that flow both inside and outside, and it often serves as a point of convergence for goals and expectations that are at odds with one another (Martini, 2009).

Having this in mind, this paper intends to analyse a case study belonging to the Made in Italy sector, trying to point out possible improvements that the Company should pursue.

2 Research Methodology

Through a qualitative analysis, this research intends to answer the research question, using the case study method. We are aware that the results provided by a single case study may not be representative of the entire universe, but at the same time this research strategy is preferred for complex and deeply rooted contexts (Audet and d'Amboise, 2001; Lee, 1999; Yin, 1992). Focusing on a single case study enhances richness and contextualisation (Dieleman and Widjaja, 2019): as Mitchell states in his famous 1984 paper "the search for a 'typical' case for analytical exposition is probably less fruitful than the search for an 'eloquent' case, in which the particular circumstances surrounding a case serve to suddenly make previously obscure theoretical relationships evident".

A single case such as the one presented in this paper adds a concrete contribution to the previous literature from a real business perspective. Our case study refers to a small Company born within a solid and well-established all-Italian multi-business group, based in Rome, which intends to apply the exclusive skills operating in other sectors to a new business model. The management's intention is to compete in a market area currently not covered by an adequate product offering. These products are marketed through an exclusive, specially created brand and are developed for the benefit of young children and their

parents. The Company is in the start-up phase and launched sales in May 2022, after two years of pre-activity.

We conducted several semi-structured interviews (primary data) with the Head of Finance department. In conducting the interview, we followed the snowball method (Morgan, 2008), which proved to be appropriate for our analysis because it allowed to obtain a substantial amount of information. Thanks to the interview process, we understood managerial thinking and purpose, the challenges that management faced and is facing. The interviews were conducted in March 2023 and lasted an average of one hour. All of them were audio-recorded and then transcribed. In the following, the outcome of the interview is reported. [1]

2.1 What is the business model and value proposition?

The idea that started this business and on which the business is articulated is that of producing toys useful for the correct growth and cognitive development of the child in the first 24 months of life, in an interaction with the parents. The toys produced are based on Montessori learning theories and in fact all products are settled and approved in consultation with the foundation.

The need to be satisfy is: "how can be improved child's cognitive development as he or she grows up?". The creation of a 'set' of play experiences, accompanied by a 'guide for parents', which teaches kids how to use the individual games contained in the box, is geared towards meeting this need. Such a guide requires the parent to actively participate in play with the child, so that this activity influences the quality of the child's growth. The necessary implication of the product (currently only the boxed product in its various variants is on sale) is that the parent must play with the child and that the child, consequently, does not play alone. The set of toys sold within the box, in fact, does not allow for autonomous play on the part of the child, but requires parent-child interaction.

2.2 What products are marketed and how are they eco-friendly?

Currently, the Company only produces and sells a box containing a set of toys, without the possibility of marketing the individual components.

[1] *Due to confidentiality reasons, the name of the Company is omitted.*

New prototypes are being developed to create another 10 new product lines that are different from each other, but always with the aim of educating children between 0-24 months.

The box currently on sale is pre-packaged and made of cardboard, is not additionally wrapped in plastic, and is 'self-shipped' when the order is placed: in fact, it is simply printed with the recipient's name, applied in the warehouse and sent by courier. It contains toys suitable for the infant's period and learning. Each box covers 2 months of the child's life, for a total of 12 boxes.

There are no sales outlets where the products can be purchased because it is sold just via e-commerce. The choice of packaging and production of the toys is as environmentally friendly as possible. The toys inside the box are in no way subjected to chemical and harmful treatments as they will come into contact with children. The toys and the box itself are also 100% recyclable.

2.3 How can be described these products?

As an instance, the first box, the one from 0 to 2 months, provides the first 'transition object', helps exercise the eye muscles, and encourages the transition from the supine to the tummy-down position. The first two months of life are a time of important development of the eyes, touch, recognition of voices and faces of loved ones. To encourage baby's first discoveries, inside the box are toys inspired by the Montessori philosophy and featuring black and white contrasts to stimulate sight, which can be used together to build a bond of trust and love.

2.4 What sales channels do you use and what products are currently marketed?

Sales take place exclusively through a dedicated online channel. As already mentioned, for the time being only the boxes and not the individual games that make them up can be purchased according to one of the following offers:

1. single box;
2. three boxes (6 months of games): at an interval of 2 months, a new box is sent, different from the previous one, with different games in line with the child's age and learning;
3. six boxes (12 months of games, extended version of the previous one);

4. subscription: you subscribe and are sent a box every 2 months, until you withdraw from the contract.

Currently 70% of the turnover is generated by the sale of the single box.

There is also the possibility of satisfying a potential customer who discovers the brand and is intrigued by it, but is still undecided. To capture this 'customer slice', the product is sent for a 15-day free trial at the end of which the customer can decide whether to buy it or return it (only 10% of customers return the product after trying it, 90% agree to keep it and pay for it).

2.5 How can the product be discovered?

The Company has two proprietary digital channels that are implemented through two downloadable applications on smartphones. The purpose of these applications is to provide general and specific information to parents or prospective parents through registration and free updates (Attract and Keeping). The information conveyed by the apps is always based on Montessori principles and has been validated and implemented by a well-known hospital complex specialising in child research.

Once registered free of charge, the user of the applications obtains constantly updated information of a general nature. This information is not directly related to the company's activities, but has a high scientific value, as it comes from an international body specialising in babies and provides advice for pregnant women and parents-to-be. On the other hand, while this information is being consulted free of charge, advertising banners for products offered by the company appear continuously and, if interested, link to the relevant e-commerce page.

2.6 How were the initial costs of setting up the company distributed?

The initial investment required a high outlay of several tens of millions of euros, which were needed for:

- personnel, which involved the creation of the transverse functions of Marketing, Finance, Business Development, with about 40 employees;
- external suppliers, freelancers who developed the product design. Currently, marketed products and prototypes are developed by various external professionals working in different areas, such as specialised designers and development psychologists;

- external manufacturing, entrusted to the leading international toy manufacturer;
- purchase of digital platforms to dialogue and maintain contact points with customers for e-commerce sales.

3 Discussion

At present, the Company is encountering difficulties in pursuing its economic viability of its business, since the level of sales volumes of the product currently on the market is lower than expected and does not allow to cover the costs. Therefore, the management, and in particular the strategic function, is currently interested in proposing improvement actions. Corporate strategy, in fact, is defined as a management activity and is dedicated to seeking economic balance in internal operational processes and in relations with the environment in which the company operates. The objective of strategic management can be defined as the definition of the fundamental characteristics of an organisation's interaction pattern with the environment, both in a political and operational context (Normann, 1987).

The implementation of this involves the development of an organisational and material framework that can best support this process. Ideas, choices and actions that directly aim at defining, creating or modifying the organisational framework of the Company's internal and external operational and competitive conditions are part of strategic management.

The processes of investment, innovation and learning are linked to the way resources and competitiveness accumulate over time, settle and stratify on the basis of an organisation's structural support system. Strategic ideas, choices and operations can have a favourable impact on the trend lines of the production mix.

The organisational framework of operational and competitive conditions comprises a set of 'factual situations' (Bertini, 1995) that, specifically, define the operational effects of enterprises and categorise their activities both internally and externally in terms of their interactions with the environment. The particular circumstances that make an individual enterprise unique, unpredictable and distinct from others even if it operates in the same competitive and environmental environment are represented by the combination of internal and external factors (Eminente, 1986).

The strategic management process operates precisely under conditions of information uncertainty. In fact, the management issues addressed by strategy concern a series of highly complex, multifaceted and interconnected business situations, both internal and external. The structural imprint determines the characteristics of strategic management to the extent that strategy determines the internal structural structure of the company and its structural relationship with the environment and change. Innovation is actually the foundation of strategy.

As a result of the interview process, some critical points were highlighted that, if analysed and implemented, could help the cost-efficiency process, because according to Bertini (1990), management is defined as the continuous integration of ideas, decisions and actions in a systematic logic. The system of business ideas is transformed into an operational system through the decision-making process. The fundamentals of business economics are to be found in this 'conversion process', in which the human system, i.e. the part relating to economics, is posed as a challenge (Ferrero, 1968).

In our opinion, these critical points are the following:

- the rigid sales channel, as it is exclusively online without the presence of the product in shops or distribution chains. This point represents a strong limitation to distribution and product knowledge, since the customer buys exclusively through a channel dedicated to new parents and does not get there through even casual acquaintance that takes place in a shop and does not have a direct interaction with a physical consultant who can show him directly and concretely the potential of the product. This on the one hand negatively affects the 'sales force' and market penetration, but on the other hand it is a positive factor in terms of localisation, as not only is it concentrated in certain physical locations, but it allows any potential customer interested in purchasing the product to be covered;

- the high cost of both the individual product and the subscription to the entire package makes the product difficult to appeal to less affluent families, who are potentially those with the most children and who should therefore theoretically constitute the most solid consumer base. This interpretation makes the product the prerogative of a small circle of potential buyers, who have to grasp the product's strong potential but also have the financial possibilities to buy it;

- the high initial start-up costs due to the remuneration of foundations, institutions and professionals for the design of the product. The design and realisation with environmentally friendly materials entailed a high initial outlay

due to the fact that specific professionals and manufacturers with specialised skills were called in and required a high initial investment, which can only be recouped with the widespread diffusion of the product. In addition, the still limited production does not yet allow for the possibility of creating economies of scale in the acquisition of finished products from their manufacturers and suppliers; - the product, due to its intrinsic characteristics, is more appreciated by a 'high culture' clientele, or in any case an attentive one. As it is presented, the product is more niche than mass consumption and is difficult to place in large-scale distribution; moreover, it is little known, as is the brand under which it is marketed.

4 Conclusions

In addition to what has been discussed in the previous paragraph and the analysis and emergence of what are some of the major, and not complete, criticalities that do not allow for initial success in economic terms, it should be added that the commercialisation of the product began relatively recently and therefore, as Giannessi (1969) writes, the transformation of a company's system of ideas into an operating system is a progressive process in which the time factor plays a significant role. We are talking about a system of operational and competitive business conditions that can be shaped and changed over time through a process of accumulation, sedimentation and stratification. The factual situations that have been assessed are not susceptible to sudden and drastic changes (Mazzola, 1993). Rather, they are structural characteristics, the purpose of which is to improve future business performance over time.

The structural characteristic must be viewed from a broader perspective and must not be used to describe the material and organisational system of the company, which only involves internal factors. On the contrary, the system of operational and competitive conditions also includes external factors, which refer to non-contingent situations and can be thought of in terms of how an organisation interacts with its environment (Bertini, 1995; Coda 1989). Insofar as these conditions are 'structural' for the achievement of future economic and business flows that have the characteristics of 'final' results (as they are already consistent with the economic expectations of investors), the system of operating and competitive conditions that has been created as a result of the management performed represents an 'intermediate' result (Galeotti and Garzella, 2013).

Most strategic decisions must be made using an approximate and incomplete information background, despite the considerable analysis efforts made by the company. Today, most organisational information systems focus on strategic analysis. Only on rare occasions is it possible to have a complete cognitive quadrilateral due to the time and cost of information and without considering the fact that, in any case, much strategic information is future-oriented and therefore uncertain and only hypothetical. Therefore, despite all rationalisation efforts, the people entrusted with corporate governance continue to have a significant impact on strategic management decisions. The creation, consolidation and modification of a structural system of operational and competitive conditions constitutes the formation of a system of ideas. These conditions continue, to the company's advantage or disadvantage, even after the conclusion of the transactions that generated them, confirming future economic trends.

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Human Resources Wellbeing in Innovative Start-Ups: Preliminary Results from a Systematic Review of the Literature

Vincenzo Corvello*

Department of Engineering
University of Messina
Contrada Di Dio, 98166 Sant'Agata, Messina, Italy

Salvatore Ammirato

Department of Mechanical, Energy and Management Engineering, University of Calabria
Building 42/C, 87036 – Rende (Cosenza), Italy

Alberto Michele Felicetti

Department of Mechanical, Energy and Management Engineering, University of Calabria
Building 42/C, 87036 – Rende (Cosenza), Italy

Giustina Secundo

Management, Finance and Technology
Università LUM Giuseppe Degennaro
S.S 100 Km 18 - 70010 Casamassima (Ba), Italy

* *Corresponding author*

Abstract

Start-ups are becoming increasingly important in driving economic growth, job creation, and wealth generation. Their success depends not only on innovative products and services but also on the ability of attracting, retaining, and developing talented employees. The enthusiasm, involvement, and effort of founders and early employees greatly impact the success of start-ups. Unfortunately, the high degree of uncertainty, the intense work and multiple roles of employees may lead to several issues like burnout risk and difficulty balancing work and private life.

Although existing research has produced several contributions on , the quality of working life for start-up employees and entrepreneurs, the knowledge generated in the field appears fragmented and the findings are sometimes ambiguous. The reason for this

fragmentation can be traced back to the lack of reference frameworks that clarify the most used concepts,thus providing a shared language.
Therefore, human resource wellbeing is a research theme that deserve to be further investigated. This study aims to provide a first attempt to consolidate the state-of-art of scholarly research in human resources wellbeing in innovative startups.. To this aim, we carried out a systematic literature review by analyzing a set of 41 papers in order to find what are the relevant topics in the investigated research domain. This activity was performed using MySLR software. In particular, we characterized the three relevant topics in the investigated research domain, namely job satisfaction, wages and career development opportunities; work-life balance and psychological wellbeing; women's condition and gender related issues.
Overall, the value of research is to provide a framework for analyzing the phenomenon of human resources wellbeing in innovative startups that can be used as a reference model for envisaging new research directions both entrepreneurship, human resources and innovation management fields of study.

Keywords – Start-ups, wellbeing, human resources, literature review

Nature of proposed paper - Academic Research Paper

1 Introduction

In recent years, innovative start-ups have emerged as key drivers of economic growth, job creation and wealth generation. These companies are often characterized by their agility, flexibility, and willingness to take risks in pursuit of breakthrough innovations and sustainable business models (Corvello et al. 2023). Innovative start-ups are often at the forefront of technological advancements and are often seen as vehicles for social change, as they can address societal challenges and create value for communities.

However, the success of these start-ups depends not only on their ability to develop innovative products and services, but also on their ability to attract, retain, and develop talented employees (Harlin and Berglund, 2021). Among the reasons for the success of many start-ups is the enthusiasm and commitment of the founders and early employees (Margherita and Verrill, 2021). The literature highlights the importance of the enthusiasm, involvement and effort produced by these people (Andries and Czarnitzki, 2014). For this reason, human resources (HR) wellbeing is a critical factor in the success of start-ups, as it can impact employee motivation, engagement, and productivity(Wiklund et al., 2019).

Start-up culture is often associated with a high degree of uncertainty and intense work. In particular, in the early stages of a start-up, there is often a great

deal of uncertainty surrounding the viability of the business model, the market demand for the product or service, and the availability of funding. This uncertainty can create a sense of urgency among start-up employees, who may feel that they need to work long hours and take on multiple roles in order to ensure the success of the company (Mukul and Saini, 2021).

While the intensity of start-up culture can be motivating for some employees, the pace of intense work and uncertainty about results can put staff and entrepreneurs under pressure with negative effects on their well-being. In fact, in uncertain working contexts, cases of burnout are not rare and entrepreneurial work makes it difficult to balance work activity with private life. Employees in start-ups may feel pressure to constantly iterate and improve their products or services, which can result in long hours and high levels of stress. In addition, start-up employees may feel that they need to constantly stay up-to-date with the latest industry trends and developments in order to remain competitive. This can take a toll on the well-being of startup employees (Omrane et al. 2018).

Start-up entrepreneurs need to be mindful of the impact that their culture and work environment can have on employee wellbeing, and take steps to promote work-life balance and employee satisfaction. This can include offering flexible work arrangements, providing opportunities for professional development and growth, and creating a supportive and collaborative work environment. By prioritizing employee wellbeing, start-ups can create a sustainable culture that promotes innovation and growth, while also valuing the health and happiness of their employees.

Despite its importance, the quality of working life of start-up employees and entrepreneurs is a topic that has not yet been investigated in the literature. How theories and models of employee satisfaction theories can be applied to this specific domain is not entirely clear. Therefore, an effort is needed to understand which are the fundamental problems and the most useful theoretical constructs. Because of the lack of such a synthesis, obtaining an overview of this fragmented domain can be difficult. To our best knowledge, this is the first systematic review article to specifically address the theme of HR wellbeing in innovative startups, aiming to provide a comprehensive/integrated analysis exploring the topics, trends, methods/variables, and constructs used in prior studies.

To achieve this goal, we analyzed papers by means of a text-mining approach, namely latent Dirichlet allocation (LDA). By analyzing the papers clustered into

these topics, we provide an integrated view of this knowledge domain and identify research limitations and gaps.

2 Methodology

We conducted a Systematic Literature Review (SLR) to provide an overview of scientific literature on the topic of HR wellbeing in innovative startups. In line with the SLR principles provided by Tranfield, Denyer, and Smart (2003), the research protocol we adopted consists of three main steps: paper location and selection, paper analysis, and results presentation/analysis. These three steps have been carried out with the support of MySLR software platform (Ammirato et al. 2022), which is a semi-automated tool supporting researchers in performing SLRs. Figure 1 shows the research workflow adopted in this research.

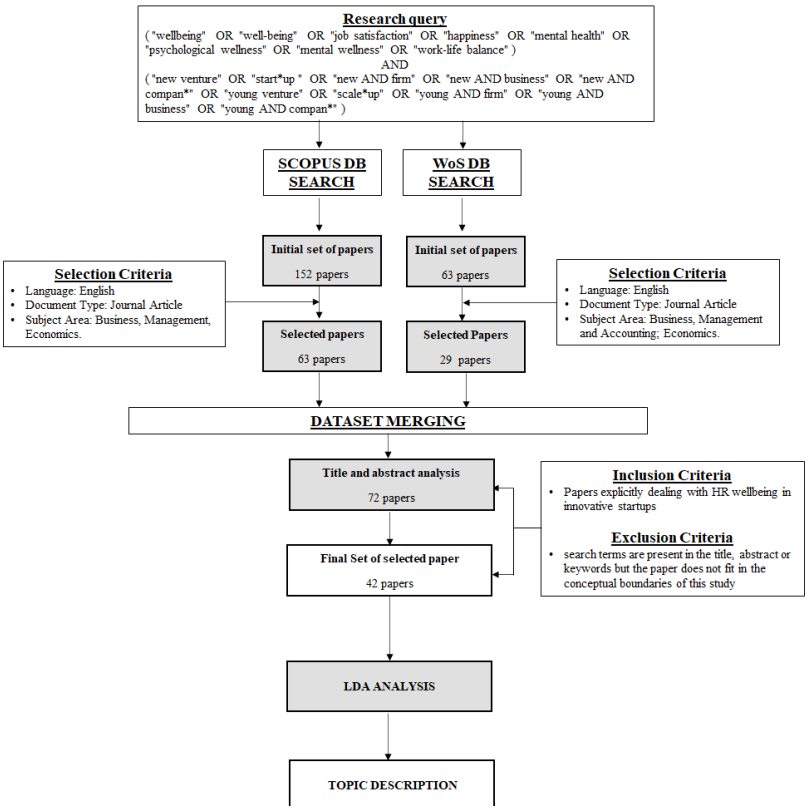

Figure 1. The research workflow

Papers location and selection. We defined two sets of keywords to identify the core literature that take into account the concepts HR wellbeing and innovative startups, respectively. The search string was designed to yield papers containing at least one term from each set in the title, abstract, and keywords.

WoS and Scopus have been selected as scientific databases were to perform our search and locate papers. These databases are considered as the most important and comprehensive databases in managerial studies (Bhimani et al., 2019). The search has been performed at the end of March 2023. We initially found 152 papers from Scopus and 63 from WoS. Selection criteria for papers to be analyzed included the following conditions: the papers were written in English, published in scientific journals, and indexed within the Business, Management, and Economics field of study (Felicetti et al., 2023). At the end of this step, we found 63 papers from Scopus and 29 papers from WoS.

Results from these two scientific databases have been merged, resulting in 72 unique papers. We manually analyzed the title and the abstract of each article, in order to verify if it falls within the scope of our study (Christofi et al., 2021). This allowed us to exclude papers that do not fit in the conceptual boundaries of this study, despite search terms are present in the title, abstract or keywords. The final set consists of 41 papers.

Paper analysis. We utilized a text-mining approach based on latent Dirichlet allocation (LDA) to reveal the research topics in the context of legal and regulatory innovation. The LDA technique gives as output k sets of relevant keywords (where each set represents a topic) and the document-term matrix, i.e. a matrix describing how much each paper is devoted to a specific topic (i.e. topic proportion). Following Blei (2012), we selected k, i.e. the number of topics to be extracted, by evaluating multiple LDA results with k ranging from 2 to 20. We chose k and the LDA algorithm to guarantee a sufficiently high value of topic coherence (Chen & Liu, 2014) and, at the same time, a simple interpretation of the results for a human reader. The most meaningful set of topics was achieved with k = 3.

Results synthesis Four topics have been identified through the LDA procedure,

In Figure 2, the intertopic distance map, a visualization of the topics in a two-dimensional space, is provided. The area of these topic circles is proportional to the number of words that belong to each topic across the dictionary. The map would seem to suggest a high degree of polarization of the terms on the individual topics. Figure 3 shows the t-distributed stochastic neighbour

embedding (t-SNE) map, i.e. a statistical method for visualizing high-dimensional data by giving each datapoint a location in a two dimensional map. The map seems suggesting that the papers that are assigned to a topic have little to do with the other topics.

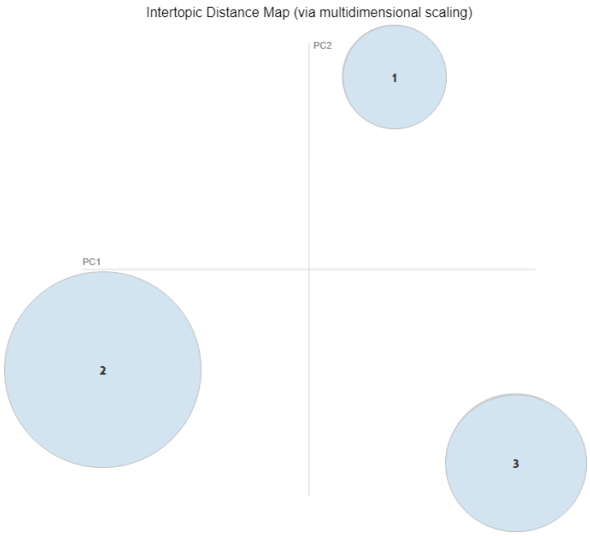

Fig 2. The intertopic distance map with three topics

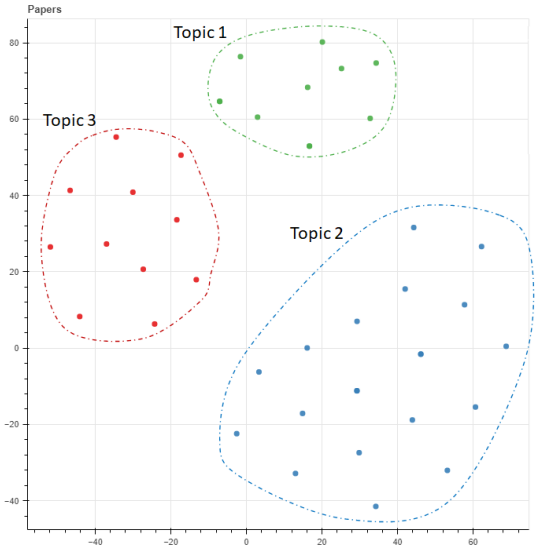

Fig 3. The t-distributed stochastic neighbour embedding (t-SNE) map with three topics.

Each topic identified through the LDA procedure is related to a different perspective. In Figure 4, a set of 10 relevant keywords associated to each topic is presented.



Fig 4. Word-cloud of relevant keywords for each topic.

This allowed as to name the three topics as follows:

- Topic 1: job satisfaction, wages and career development opportunities
- Topic 2: work-life balance and psychological wellbeing (mental health of individuals involved in innovative startups, including stress, anxiety, depression, burnout)
- Topic 3: Women's condition and gender related issues.

3 Discussion

In this section, a description of the three topics detected through the LDA procedure is provided. In particular, the description is developed on the base of papers' main concepts proposed.

Topic 1: job satisfaction, wages and career development opportunities. Job satisfaction, is a critical factors in the well-being of human resources in innovative startups.

Job satisfaction in startups is a multifaceted concept that involves various factors such as salary, opportunities for advancement, colleagues, management, and the nature of the work itself (Yang et al., 2019). While compensation, benefits, and job security are important factors that shape employee satisfaction, other

factors such as opportunities for growth, progress, and career advancement also play a significant role (Jeong and Choi, 2017). Additionally, intrinsic rewards such as recognition, praise, and flexible working arrangements could also contribute to job satisfaction (Georgellis and Yusuf, 2016).

As a complex construct, job satisfaction is influenced by various factors, such as the work environment (Kanchana and Jayathilaka, 2023), job characteristics (Maaravi et al., 2021), and organizational culture (Muttaqin et al., 2020).

Startups that provide employees with autonomy, meaningful work, less routinary activities and opportunities for personal and professional growth are more likely to have satisfied employees (Maaravi et al., 2021). Also startup entrepreneurs tend to experience greater life satisfaction due to their ability to work independently, have greater flexibility, and utilize their skills more effectively (Naudé et al., 2014; Binder and Coad, 2013). This is based on the assumption that having greater autonomy in their work life leads to positive emotions and a sense of fulfilment from running their own business (Teixeira and Vasque, 2020).

Startups often face financial constraints, and offering competitive wages may be challenging. They often suffer from the inability to provide competitive salaries as per industry standards (Mukul and Saini, 2021). This can make challenging for startups to attract and retain highly skilled individuals. Hence, startups search for new and creative ways to remain competitive, such as offering alternative compensation considerations and strategies, e.g. benefits, equity compensation and stock options (Freeman and Angel, 2007). Chang et al. (2015) found a positive effect of non-executive employee stock options on their long-term commitment, preventing myopic behaviours, with a substantial impact on innovation output. Of course, Startups that provide employees with fair and competitive wages are more likely to have satisfied and motivated workers (Sorenson et al., 2021). Startups offering competitive wages have been found to attract and retain high-quality employees (Kim, 2018).

Career development opportunities are also essential for employee well-being. Several studies have shown that employees who perceive that they have opportunities for career development are more satisfied with their jobs and are more committed to their organizations (Fackler et al., 2019). Startups that provide employees with opportunities for career growth and development are more likely to have satisfied employees (Jia-Jun and Hua-Ming, 2022). Therefore, innovative startups should provide employees with opportunities for career growth and development to foster employee well-being.

Topic 2: work-life balance and psychological wellbeing

The concept of work-life balance has become increasingly important in recent years, particularly in the context of innovative startups. Innovative startups are known for their fast-paced, high-pressure work environments, which can make it difficult for employees and founders to manage their professional and personal lives. This can have a significant impact on their wellbeing, both in the short and long term (Rashmi and Kataria, 2021).

Thilagavathy and Geetha (2021) identified three level of factors impacting on work-life balance, namely, individual, organizational and societal factors. Innovative startups have the opportunity to create a culture that values work-life balance and supports employees in achieving it. This can include offering flexible work arrangements, providing resources for mental and physical health, and promoting a culture of work-life balance (Thilagavathy and Geetha, 2021).

While working for a startup can be exciting and offer opportunities for growth, it can also be stressful. The psychological wellbeing of individuals involved in innovative startups has received increasing attention, as the high-pressure environment can result in stress, anxiety, depression, and burnout (Katrodia, 2020). Research indicates that startup founders experience higher levels of stress compared to employees in traditional organizations (Nambisan and Baron, 2021). This is attributed to factors such as the need to raise capital, deal with uncertainties, and manage a rapidly growing team (Wincent and Örtqvist, 2009)

High levels of stress, in turn, have been found to have a wide range of negative effects on employees and startups entrepreneurs, including their ability to make judicious decisions and actions and more broadly, on their performance on a wide range of tasks (Rangrez et al., 2022). Entrepreneurs' passion for their startup can lead to chronic stress, which can have negative effects on their physical and mental health. It is crucial educating entrepreneurs to work through the stresses of entrepreneurship more effectively, leveraging on self-awareness and resilience in managing stress (Cotter and Stetson, 2020).

Employees in innovative startups are also at risk of experiencing burnout due to long working hours, high job demands, and the pressure to meet performance targets (Wiklund et al., 2019). This is particularly evident in necessity-based startups (Kautonen and Palmkroos, 2010). Nikolova (2019) provided causal evidence of the consequences of switching to self-employment from unemployment (necessity-based) and to self-employment from regular employment (opportunity-based). Specifically, the author found that necessity

entrepreneurs does not experience substantial improvements opportunity entrepreneurs experience benefit in mental health. Kollmann et al. (2019) examined how daily stressors affect entrepreneurs' insomnia and their ability to detach from work during non-work hours, with a significant impact on their wellbeing and performance.

Some startups entrepreneurs are involved in *hybrid entrepreneurship activities*, i.e. they are simultaneously working in wage employment settings while also attempting to launch their own new ventures (Folta et al., 2010). Hybrid entrepreneurs face significant time constraints, requiring availability for extended work overtime (Kim et al., 2022). This condition of dual work-venture role engagement often leads to negative psychological pressures and increasing dissatisfaction (Carr et al., 2022).

The workplace must be a source of happiness for employees. Unhappy employees in a workplace tend to increase employee turnover, absenteeism, low productivity, and time wasted deadlines (Kanchana and Jayathilaka, 2023).

Topic 3: Women's condition and gender. The challenges and opportunities associated with employee wellbeing in innovative start-ups are closely tied to issues of gender, career aspirations, emotional wellbeing, work-life balance, and motivation. Women may face unique challenges in balancing work and family responsibilities, which can impact their career aspirations and motivation (Aggrawal et al., 2022)

Issues Gender and equity-related issues in innovative startups are an important aspect to consider, as research indicates that there is a significant gender gap in the startup ecosystem (Berger and Kuckertz, 2016). Female founders and employees often face unique challenges, such as gender discrimination and bias, which can impact their wellbeing and career development. Gender discrimination in access to funding is a significant issue for women entrepreneurs in startups.

Research on gender and equity in innovative startups has mainly focused on the underrepresentation of women in the sector (Brush et al., 2019). Studies show that women-led startups receive a disproportionately low amount of venture capital funding, with only 2.3% of VC funding going to women-led startups (Bittner and Lau, 2021). Similar results are provided by Demartini (2018). Her study highlights that female businesses raise, on average, a lower amount of financial resources in comparison to men. This underrepresentation can be attributed to factors such as gender stereotypes, lack of access to resources and networks, and unconscious bias among investors (Ewens & Townsend, 2020).

Moreover, the underrepresentation of women in innovative startups is due to the fact that technological-related activities have traditionally been a "male domain (Demartini, 2018).

In terms of wellbeing, studies have shown that female startup founders experience higher levels of stress compared to their male counterparts (Chadwick and Raver, 2019).

Work-family conflict is a relevant issue in gender studies on startups well-being. Time management played a crucial role in the lives of each of the women as they coordinated various roles: business owner, wife, mother, carer. a key motivation for engaging in venturing is the desire to balance familial responsibilities with running their own business and, thus, fulfil an ambition to be their own boss. Women in startup companies experience what Kamberidou calls *multitasking whirlpool,* i.e. the "experience of being pulled in all directions: juggling professional, social, family and domestic obligations while pursuing individual or creative goals and needs"(Kamberidou, 2020, p.4). Increased flexibility was expected to help them to realize that ambition. Entrepreneurship offers a partial answer to both a desire for greater flexibility and control over personal time and the need to take control over personal and professional ambitions (McGowan et al., 2012).

Innovative startups can promote gender and equity by providing a supportive work environment that encourages diversity and inclusion. Additionally, providing individuals with opportunities for personal and professional development can help to build resilience and coping skills, which can improve gender and equity related issues (Yang et al., 2020)

4 Conclusions

We carried out a systematic literature review on human resources wellbeing in innovative startups. This article aims to lay the foundations for the extension of organizational theories on employee well-being to the case of start-ups.

This research allowed us to identify multiple dimensions of wellbeing in the context of innovative startups. By identifying three distinct but interrelated topics, this study highlights the complexity of human resources wellbeing in this context and the need for a multifaceted approach to addressing it.

The study provides insights for entrepreneurs and managers of innovative startups on how to promote employee wellbeing, as the importance of

addressing mental health issues in the context of innovative startups, prioritize the implementation of mental health support programs and create a supportive culture that values employee wellbeing.

As far as the authors are aware, this is the first article that systematically addresses the issue. The results are of interest to innovation and entrepreneurship scholars, who will find in the article indications for better understanding the motivational and behavioral dynamics of people in start-ups. The same holds for human resource management scholars, who will find indications for extending their domain theories to this interesting field. Finally, our results are useful to entrepreneurs and employees of new businesses, because they can draw lessons relating to the management of people and interpersonal relationships, and for policy-makers, interested in the success of start-ups but also in the well-being of employees in a sector that employs an ever growing number of people.

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Knowledge of ESG Factors and Firm Efficiency for Supporting the Bank Risk-Taking: An Empirical Analysis

Giovanni Baldissarro*

Department of Mechanical, Energy and Management Engineering
University of Calabria
Building 41C, 87036 Rende (Cosenza) - Italy

Maria Elena Bruni

Department of Mechanical, Energy and Management Engineering
University of Calabria,
Building 41C, 87036 Rende (Cosenza) – Italy

Gianpaolo Iazzolino

Department of Mechanical, Energy and Management Engineering
University of Calabria
Building 41C, 87036 Rende (Cosenza) – Italy

Donato Morea

Department of Mechanical, Chemical and Materials Engineering
University of Cagliari
Via Marengo 2, 09123 Cagliari – Italy

Stefania Veltri

Department of Business Administration and Law
University of Calabria
Building 3C, 87036 Rende (Cosenza) - Italy

** Corresponding author*

Abstract

Knowledge of the Environmental, social, and governance (ESG) factors is the subject of increasing interest in national and international institutions. Within the banking sector, there is a growing awareness of the need to integrate the non-financial information arising to ESG factors knowledge, into strategies, processes, and financial instruments to generate

long-term value. ESG are increasingly considered as a new factor influencing risk in bank's lending activity, and this is the perspective of our paper. Adopting a bank-centered perspective, the main aim of the paper is to investigate, employing a Data Envelopment Analysis (DEA)-based approach whether including ESG factors in the creditworthiness assessment of borrowers increases the firms' efficiency, thus mitigating bank risk taking. The research has been carried out on a sample of European listed firms in the energy sector, which is under increasing pressure from society due to its huge environmental footprint and social importance. Our findings do not provide evidence of the overall significance of ESG factors in affecting firm efficiency. Nevertheless, we provide evidence that high/low ESG scores do not affect firm efficiency, but at moderate level, ESG scores improve the corporate efficiency. The findings contribute (and provide suggestions) for regulators, credit risk managers, and academics.

Keywords – Knowledge, ESG factors, Creditworthiness, DEA, Sustainability

Paper type – Academic Research Paper

1 Introduction

Knowledge of non-financial information, related to the concept of sustainability, has become crucial in the banking context. Nowadays, it is no longer enough to look at financial data alone to evaluate a company, as for all global companies, compliance with values related to sustainability has become a must. Traditional accounting methods that exclusively considered the financial results of corporate operations do not match the needs of organizational stakeholders in today's global business environment (Gurol & Lagasio, 2022). The request for non-financial information (NFI) has led businesses to disclose it in sustainability reports (SRs)/non-financial reports (NFRs) to address the greater stakeholder demands in environmental, social and governance (ESG) issues (Degan, 2002), even if methodologies for sustainability reporting are not consolidated yet (Patara & Dhalla, 2022). ESGs reflect sustainability practices and are able to report a firm's progress in implementing the SDGs (Khaled et al., 2021). Only recently have banks attached increasing importance to CSR and sustainability reporting, also including stakeholder engagement and ESG disclosure (Bătae et al., 2021; Venturelli et al., 2018). Among the reasons, we can quote the need to recover the reputation compromised by a series of scandals that revealed the social and environmental impact of banks (Venturelli et al., 2018); the 2008 financial crisis, which increased the need for trust as well as accountability and transparency between banks and their stakeholders (Lentner et

al., 2015); the willingness of banks to develop their brand identity and to differentiate themselves from competitors by investing in CSR (Forgione & Migliardo, 2020); an expected superior financial performance for banks involved in CSR activities (Shen et al., 2016). The changed scenario has not only prompted financial intermediaries to analyze and manage relations with various stakeholders more carefully, but also attracted increasing attention from banks to CSR and the adoption of social reporting. The need to improve the reputation and fiduciary relationship with stakeholders was the primary reason for convincing credit institutions to use social reporting tools aimed at communicating their commitments and the overall impact of their ESG activities on the community and to manage their reputational risk (Galletta et al., 2022; Dell'Atti et al., 2017). Knowledge of companies' ESG commitment is extremely important for banks as banks have a fundamental impact on the overall economy, performing the function of transferring funds, and the sensitivity of bank managements regarding sustainability can reflect this in their lending decisions, so highlighting an indirect environmental impact (Gurol & Lagasio, 2022). ESGs, beyond being viewed as a new virtuous approach to business, probably profitable in the near future, could be analyzed in terms of risk. Integrating ESG factors into credit risk assessment is the most novel challenge for the financial industry (Brogi, 2020) and also an opportunity to create sustainable lending (Brogi et al., 2022). In some cases, ESG disclosure contributes to decrease corporate financial irregularity risks (Yuan et al., 2022). This is a timely issue, as regulators and investors increasingly require banks to channel loans to "sustainable" borrowers and ultimately foster sustainable growth. From a regulatory perspective, the new European Banking Authority (EBA) guidelines (EBA, 2020) have set out a series of principles for credit institutions to follow in managing and controlling credit risk which not only focus on the financial and capital structure of firms but also on environmental, social and management factors and qualitative and prospective information. The integration of environmental sustainability criteria in investment decisions and in support of the development of sustainable finance is required for different banking business models. While the banking system is aware of the strategic importance of ESG issues, their practical introduction into lending processes is still extremely heterogeneous and fragmented. This is clearly an issue that needs to be addressed, since credit institutions have time to adapt by 30 June 2024 (Galletta et al., 2022). This paper focuses attention on the bank's lending decision, aiming to investigate whether including ESG factors in the

creditworthiness assessment of borrowers increases the efficiency of firms, thus mitigating the bank risk taking. To the best of our knowledge, in the extant literature there is only one other attempt to explicitly integrate ESG factor in the creditworthiness assessment. In detail, the article of Brogi et al. (2022), adopting a bank perspective, found that ESG scores are strongly and very significantly associated with a reduction in firm credit risk. Differently from Brogi et al. (2022), in our paper, we use a DEA-based approach to take into consideration the non-linearity concerns related to a (supposed) identified non-linear association in the literature between ESG and firm performance/firm risk (Rouine et al., 2022; Barth et al., 2022; Bruna et al., 2022). The contributions of our paper are manifold. Our results might contribute in terms of policy by developing a new perspective of the whole credit risk management process, which includes knowledge of ESG factors. Policy makers should thus reflect on the role of ESG in the regulatory framework and in the prudential treatment of sustainable lending. Our findings are interesting for practitioners, as they are in line with the EBA guidelines (EBA, 2020) requiring banks to deepen the knowledge of factors related to sustainability in their lending decision. Moreover, they can also help credit risk managers to reflect on the role of ESG awareness in credit risk assessment in periods of crises (Demers et al., 2021) and on the opportunity to adopt a sustainable lending policy to achieve competitive advantage. Lending to sustainable firms is less risky, more advantageous from a competitive point of view and presumably produces less risk weighted assets when computing banks' capital requirements (Brogi et al., 2022). Finally, from the academic research perspective, we contribute to the literature on ESG and credit risk assessment by adding knowledge to the research on the association between ESG and borrower's credit risk, which is still a topic without univocal consensus, and in a sector, the financial sector, that is nowadays an under-investigated topic in the literature.

The paper is organized as follows: Section 1 introduces the topic; Section 2 presents the literature review; Section 3 illustrates the data set used; while Section 4 describes the methodology employed; Section 5 presents and illustrates the empirical results; finally, Section 6 concludes the paper.

2 Literature review

Theoretically speaking, at least two established theories can be used to support a link between bank risk-taking on the one hand and ESG on the other. The

stakeholder theory (Freeman, 1984) suggests that a shift from shareholder-focused to stakeholder-focused governance would balance the interests of investing and non-investing stakeholders in banks thereby containing excessive risk-taking by management and protecting bank value. ESG-based governance should therefore be associated negatively with bank risk-taking (Di Tommaso and Thornthon, 2020). In contrast, under the *overinvestment hypothesis*, ESG leads a firm to divert scarce resources from the maximization of shareholders' wealth, which squeezes out investment, thereby reducing bank value; it therefore predicts a negative impact of ESG on bank performance (Drago et al., 2019). The "stakeholder" versus "overinvestment" debate raises a crucial question, investigating the impact of ESG in reducing (increasing) organizational risk (organizational accounting or market performance).

Empirical studies could be divided into two groups: (a) the studies that analyse the impact of the three pillars of ESG on firm performance; (b) the studies that analyse the impact of the three pillars of ESG on firm risk, in turn articulated into (1) studies focused on all sectors and (2) studies focused on the banking sector. Empirical findings of both strands are mixed. In the first strand, Friede et al. (2015) in their meta-analysis on 2200 studies, found that roughly 90% of studies show a non-negative ESG-Corporate Financial Performance relation, and the large majority of studies reports positive findings. Bruna et al. (2022), provided evidence for a positive and significant impact of ESG performance on financial performance, within a non-linear relationship. Landi and Sciarelli (2019) investigating the FTSE MIB Italian listed companies for 2007-2015 did not find statistical evidence on the abnormal returns of sample companies. Demers et al. (2021) provided evidence that ESG were not significant in affecting stock returns in COVID crisis. As regard the COVID-19, El Khoury et al. (2022) argue that it was an extreme event where the effect of ESG sharply manifests. The found that ESG is beneficial during COVID-19, but the reward appears to be closely tied up to specific aspects of ESG, income level, and firm-specific variables.

As well, Fonger-Laronde et al. (2020) found evidence that ESG investments do not safeguard from financial losses during a severe market downturn. Dimson et al. (2020) and Alda (2021) argued that the ESG factors do not affect the financial performance of mutual funds, whilst Plagge and Grim (2020) underlined that the significant return and risk differences of ESG funds appear to be mainly driven by fund-specific criteria rather than by a homogeneous ESG factor. Some other studies underlined possible differences between firms with high or low ESG

ratings (Pacelli et al., 2022). Cerqueti et al. (2021), measuring the impact of portfolio liquidation in a stress scenario on funds with different ESG ratings, found that the relative market value loss of the High ESG ranked funds is lower than the loss experienced by the Low ESG ranked counterparts in a lower-volatility period, but they do not find differences in high-volatility period of one class over another. Steen et al. (2020), analysing the Morningstar's ESG ratings and the performance of Norway mutual funds, did not find evidence of rating level effects, but dividing the sample into ESG quintiles, they found significant higher returns for the top ESG quintiles. Zhou et al. (2022) analyzing Chinese listed companies from 2014 to 2019 found evidence that the improvement of ESG performance can enhance the market value of the company through the mediating effect of the financial performance. Xie et al. (2019), examining the effect of ESG on firm efficiency provided evidence that ESG disclosure has a positive association with corporate efficiency at the moderate disclosure level, rather than at the high or low disclosure level. Pacelli et al. (2022), examining the link between the risk-return performance and the ESG score of different sectoral portfolios entirely composed of ESG assets, found that the average return is positive but the performance is still heterogeneous among the different sectors, implying that an ESG score cannot yet be considered an additional and uniformly valid ex ante criterion in selecting assets for portfolio managers. As for financial companies, Ahmed et al. (2018), investigating 30 private commercial banks operating in Bangladesh, found that banks pioneering in incorporating ESG factors in lending decisions are compensated through better financial performance. Di Tommaso and Thornton (2020), examining European banks, find that ESG scores are strongly associated with a reduction in the market value. Azmi et al. (2021) provided evidence of a non-linear inverted U-shaped relationship between ESG and bank performance, mainly driven by the environmental pillar.

In the second strand, Barth et al. (2022), investigating the association between ESG ratings and the credit default swap (CDS) for European and US firms from 20076 to 2019 found evidence that higher ESG ratings mitigate credit risks according to a nonlinear association. Rouine et al. (2022), investigating S&P500 listed companies between 2002 and 2017, provided evidence of a nonlinear and wholly negative relationship between ESG and firm total risk, also showing that the mitigating impact of ESG on corporate risk appears more marked beyond a defined score of ESG, suggesting a "threshold effect" induced both by organizational learning and responsible regulations. As for financial companies,

Drago et al. (2019), examining the changes in ESG rating announcement on CDS spreads of European firms, found evidence that better CSR ratings, in terms of both the overall score and the scores for the three main ESG pillars lead to lower CDS spreads, even if an ESG upgrade leads to an immediate and significant decrease whilst an ESG rating downgrade does not have a significant immediate impact on CDS spreads. Di Tommaso and Thornton (2020), examining European banks, found that ESG scores are strongly associated with a reduction in risk-taking. Neitzert and Petras (2021), conducting their research on worldwide banks from 2002 to 2018 provided evidence of the risk-reducing benefit of CSR engagement proxied by the ESG score (driven by environmental pillar). Landi et al. (2022) explored the relationship between companies' ESG assessments and their risk (systematic and volatility) exposures for a sample of 222 large-cap companies belonging to the S&P 500 stock market index for 2014-2018, finding that ESG assessment tends to increase firms risk exposure, and the uncertainty among investors. Galletta and Mazzù (2022), estimating a dynamic panel data model of worldwide listed banks from 2011 to 2020, found evidence that banks with fewer ESG controversies (proxy for bank compliance towards ESG issues) take less risk and Aouadi and Marsat (2018) found that, when interacted with the corporate social performance (CSP) score, ESG controversies to be positively and significantly associated with firm value. Brogi et al. (2022) found that ESG scores are strongly and very significantly associated with a reduction in firm credit risk.

Given the existence of different theories able to explain the impact of ESG on firm performance/risk and given the mixed evidence of the ESG/performance association both in financial and non-financial sectors, we believe that the issue deserves a deeper analysis. In details, our main research question is whether bank managers, in taking their lending decisions should complement their credit risk management models with ESG scores. In other words, how ESG factors can be introduced into the credit decisioning process with the aim of identifying credit opportunities that enable more sustainable future businesses? Should ESG scores be included as relevant factors in bank lending decisions? While ESG may be considered an important part of a firm assessment, they should not completely replace or be seen as interchangeable with traditional financial indicators. Successive sections deal with the sample and data selection and the methodology employed to carry out our research.

3 Methodology

Lending is one of the main types of banking operations, as a source of high profit, and in response to an increasing demand from business entities of lending volumes. The provision of bank loans is a fairly risky activity, and most of the risks associated with it are objectively inherent to the lending process. In-depth analysis of financial indicators of a firm allows the bank to obtain the necessary information on credit risk, giving an indication on whether borrowers will be able to repay the credit. For the bank, the purpose of a credit risk assessment is to make a decision whether to lend or not with the aim of maximizing the profit of the credit portfolio and hence to increase the number of loans. The essence of this credit portfolio optimization problem is then to select borrowers from a set of firms asking for credit, according to one or more decisional criteria.

We need to consider, in particular, two distinct dimensions: 1. the ability of the bank manager to increase the value of the loan portfolio; and 2. the ability of the bank manager to maximize the profitability, and hence, the number of loans. Value could be measured by market value indicators such as Tobin's Q (e.g., Bolton,2013), financial values such as revenues and EBITDA, asset values such as value of total assets and the book value of capital (e.g., Abuzayed et al., 2009). Having obtained these characteristics, we decided to employ the Data envelopment analysis (DEA), consistently with Xie et al. (2019). Using DEA allows us to estimate corporate efficiency by considering several input and output factors. Several methodologies are used in empirical papers to investigate the relation between ESG and firm performance/credit risk, going from static to dynamic panel regressions (Zhou et al., 2022) to machine learning techniques and ordered logistic regression (De Lucia et al., 2020). Many articles have underlined the existence of a non-linear association between ESG scores and firm performance/risk (Barth et al., 2022; Bruna et al., 2022; Rouine et al., 2022; Azmi et al., 2021). Given a supposed nonlinear relationship on the basis of the literature between corporate efficiency and ESG scores, we employed data envelopment analysis (DEA, for short), a non-parametric approach usually used to evaluate the efficiency and inefficiency of a group of companies, called decision-making units (DMUs, for short). DEA can be also used as an early warning index for determining firm credit risk (Iazzolino et al. 2013; Bruni et al., 2014). In this approach, the efficiency measure is derived from the optimal solution of a mathematical model where multiple Input-Output variables are considered for each company.

Traditionally, DEA has some shortcomings when applied to portfolio selection, which is in fact usually performed into two separate steps. In this first step DEA is applied to obtain an assessment of the performance of each company, and then, is a second step, an asset allocation optimization model is applied. To overcome this drawback, we present a novel model (reported in the Appendix), of general applicability, providing an integrated framework for loan portfolio selection which takes into account all the characteristics of the decision problem faced by the banks. The mathematical model that we used, through a two-stage application, allowed us to derive meaningful information on the impact of ESG factors, both on business performance in terms of efficiency and on the investment decisions of financial institutions. This is accomplished by means of weighted sum of two different objective functions into a simultaneous DEA model (Khodaparasti et al. 2015).

Additionally, the model explicitly accounts for the risk connected to the issuance of bank loans, which is intrinsically tied to the lending process. In our model, risk is associated with possible losses of a bank for a specific credit portfolio, in the event of the borrower defaulting on his obligations. In particular, the risk is defined through a constraint which takes into account as the product of the Probability of Default and the 20 percent of total corporate debt. In the model, through this constraint we limit the expected portfolio loss at a value equal to 5 millions of euros

4 Sample and data source

We decided to address our research question in an environmentally sensitive sector-namely the energy industry— where firms are exposed to higher social pressures and public concern. Consistently with Manes-Rossi and Nicolò (2022) and Adamkaite et al. (2022), we believe that is interesting to research under a sustainable angle as it is under stronger pressure and risk of losing its legitimacy. Notwithstanding the energy industry is among the industries with the most significant environmental impacts, extant sustainability accounting research is scarce in the energy industry (e.g., oil & gas, electricity, renewable energy, consumable fuels). According to the International Energy Agency, energy-related carbon dioxide (CO2) emissions are the majority of global greenhouse gas (GHG) emissions, while oil and gas are the largest sources of fuel combustion emissions and are responsible for approximately 53% of global energy-related CO2

emissions. Sustainability has long been a critical consideration for firms operating in the energy industry. Adherence to health, safety, and environmental regulations and increasing contributions to the societies in which they operate form the core of existing sustainability strategies, which enhance these firms' ability to create long-term value. These firms now have goals of achieving cost-efficient and environmentally-friendly operations. Particularly among the younger generation, the environmental impact of energy activities has led to an unfavorable perception of the industry. In addition to focusing on reputation management, firms in energy industries have other incentives to prioritize sustainability. Among them are compliance with a growing list of environmental regulations, pressure from shareholders and staff, and a desire to do what is suitable for the planet's future (Kaupke and zu Knyphausen-Aufseß, 2022). In detail, we focused our research on European energy sector listed companies. The extensive regulatory process the EU has begun to institutionalize ESG disclosure inside corporate reporting procedures served as the driving force behind the decision to concentrate on Europe (Baumüller and Sopp, 2022; Manes-Rossi and Nicol, 2022). The EU released Directive 95/2014 on October 22, 2014, as a component of the CSR strategy for 2011–2014. This directive established a "reporting cut-off point" between the European region and the other geographical contexts by imposing specific nonfinancial disclosure requirements on all public interest entities with more than 500 employees (EU, 2014). More recently, a proposal for a Corporate Sustainability Reporting Directive (EU Commission, 2021) was launched to expand the scope and reporting requirements of Directive 95/2014 and the new CSRD has been published in November 2022. At the same time, specific sustainability reporting standards have been under development by the European Financial Reporting Advisory Group (EFRAG) to increase the comparability and reliability of non-financial reports (Agostini et al., 2022). In particular, we investigate the relationship between ESG factors and financial performance, focusing on sustainability sensitive sector, namely the energy industry, where firms are exposed to higher social pressures and public concern. The data provided by these organizations can be considered reliable as they provide an independent evaluation and follow a rigorous process. We are conscious that the disagreement between ESG ratings is far larger than between credit ratings (Buallay, 2019) and that ESG ratings evaluated by different providers are not homogeneous (Berg et al., 2020). This could create confusion for investors (Halbritter and Dorfleitner, 2015) and scarce

comparability of information (Pacelli et al., 2022), mainly due to a divergence of measurement (Berg et al., 2022). In detail, the financial and sustainability data, i.e. ESG scores, will be collected from Refinitiv Eikon ASSET 4, a database widely used in the financial industry (Pacelli et al (2022); Demers et al. (2021); Landi et al. (2022). Refinitiv ESG, a significant provider of ESG ratings, is regarded as one of the meticulous and reliable providers of ESG data (Berg et al., 2021). In 2017, Thomson Reuters made significant changes in Asset4's rating process and rebranded Asset4 as 'Thomson Reuters Environmental, Social and Governance (ESG) scores. Although Asset4's methodology partially changed in 2017, its overall structure remains intact. This CSR database constructs its ratings at four levels: at the first level, there are a large number of data points; at the second level, the data points are combined into indicators; at the third level, these indicators are synthesised into different categories (e.g., 18 categories in 2014) and at the fourth level, the various categories are composed of few pillars. Before 2017, Asset4 comprised four pillars: (1) environmental pillar, (2) social pillar, (3) corporate governance pillar and (4) economic pillar. In 2017, the economic pillar was removed, leaving three pillars (the environmental pillar, social pillar and corporate governance pillar). A new pillar was introduced, namely, ESG Controversy, which comprises 23 controversy indicators. After 2017, the overall rating (i.e., ESG Score) is the equal weighted average of indicators of the environmental pillar, social pillar and corporate governance pillar (De Villiers et al., 2022). The Refinitiv ESG scores seem to be particularly suitable for our purpose thanks to their high informative power and widespread application in the financial industry. The data are shown in Table 1.

Table 1 – Data

DMU	Total Assets	Total Equity	EBITDA	Revenue	ESG	Total Debt	PD	Rating
dm1	1074.94	442.35	50.71	544.58	56.91	43.15	1.687%	6.00
dm2	2560.76	751.23	118.36	2805.98	72.03	685.23	0.512%	3.00
dm3	219155.10	58339.50	9144.36	86746.95	85.53	13.416.20	0.280%	11.00
dm4	2765.50	916.81	285.43	726.03	76.49	225.45	1.333%	3.00
dm5	2217.88	692.38	490.38	503.48	25.26	155.88	0.208%	10.00
dm6	9008.92	2990.03	768.12	1053.60	83.46	970.44	0.714%	11.00
dm7	109648.00	37415.00	9240.00	43987.00	81.20	6.340.80	0.311%	10.00
dm8	3162.70	74.69	349.71	707.32	43.55	351.29	0.415%	2.00
dm9	102193.61	27735.21	10763.13	37462.56	81.39	6.241.71	0.212%	6.00
dm10	1368.02	441.87	42.13	270.00	52.99	101.9	0.290%	5.00
dm11	3019.11	1892.89	680.71	991.03	55.82	208.53	1.912%	6.00

dm12	1701.04	702.07	146.04	1386.30	73.77	95.85	0.265%	8.00
dm13	12492.00	3160.00	1091.00	11568.00	76.78	966.4	0.396%	9.00
dm14	47261.30	23131.88	4076.00	22188.49	62.28	1.951.97	0.344%	2.00
dm15	259124.12	157989.26	15546.36	70146.26	59.61	11.452.67	0.226%	6.00
dm16	1269.63	761.32	63.29	130.76	56.95	57.04	0.335%	14.00
dm17	4801.59	2542.61	187.02	4593.37	40.11	178.98	0.179%	11.00
dm18	7764.27	873.91	1433.64	1976.26	58.27	380.37	0.631%	8.00
dm19	911.73	789.65	15.56	512.57	44.44	7.43	0.500%	14.00
dm20	8043.07	3414.40	467.21	6193.65	56.61	352.61	2.374%	6.00
dm21	6498.60	2961.40	612.00	1190.00	67.21	531.54	0.250%	10.00
dm22	15257.49	6105.96	1413.97	11066.57	64.78	630.6	0.207%	11.00
dm23	3408.73	1005.10	102.17	6120.44	68.33	301.66	1.186%	9.00
dm24	9815.00	5925.00	2357.00	11751.00	70.77	261.4	0.118%	15.00
dm25	66484.68	45750.43	7826.14	62576.79	79.21	1.464.08	0.302%	7.00
dm26	170329.04	52219.44	11684.46	63881.71	77.21	9.747.04	1.367%	3.00
dm27	22849.37	17975.69	1730.58	7898.52	64.36	516.22	0.082%	11.00
dm28	49271.00	13740.00	4455.00	16550.00	81.09	2.387.20	0.241%	11.00
dm29	3415.21	329.98	162.94	3341.52	69.81	182.26	1.046%	12.00
dm30	1714.40	324.57	203.31	387.46	61.56	214.36	2.970%	5.00
dm31	449.52	240.48	55.68	116.27	48.64	8.86	0.321%	7.00
dm32	18464.36	9138.15	982.45	18932.73	61.93	860.04	0.422%	11.00
dm33	13812.02	9693.96	1882.95	8611.12	49.23	183.84	0.185%	15.00
dm34	49302.00	20295.00	3263.00	33282.00	82.45	3.111.80	0.169%	10.00
dm35	4928.62	2501.05	506.40	3902.00	70.20	286.1	0.503%	14.00
dm36	11262.00	2923.00	605.00	7399.00	89.35	691.2	2.540%	8.00
dm37	9076.40	2093.67	885.12	2862.52	69.33	920.66	0.453%	9.00
dm38	4223.88	1691.45	415.95	749.93	47.40	499.11	0.914%	8.00
dm39	310544.64	127167.83	24169.34	147828.61	88.52	17.688.37	0.255%	11.00
dm40	16341.51	4934.09	348.62	9483.21	68.50	334.08	2.991%	7.00
dm41	25675.00	6469.00	2165.00	2770.00	88.84	3.187.40	0.306%	12.00
dm42	75893.86	64097.06	6957.59	22631.40	75.93	41.37	0.237%	5.00
dm43	14019.59	9184.14	2029.72	9031.33	46.49	139.91	0.318%	13.00
dm44	11230.82	9222.05	522.51	4214.15	67.48	143.51	0.604%	8.00
dm45	1644.82	1038.78	219.50	294.77	68.30	9.89	0.178%	9.00
dm46	1636.49	833.10	241.63	611.94	61.67	137.95	0.725%	9.00
dm47	217908.88	84911.20	16014.91	98013.64	90.07	12.394.50	0.203%	10.00
dm48	47967.68	30641.40	7084.92	15326.44	47.25	1.896.38	0.186%	9.00
dm49	17853.12	9360.52	1061.16	2580.86	54.48	1.351.18	1.374%	3.00
dm50	18160.00	4654.00	1391.00	14819	79.24	270.8	0.268%	15.00

In our sample, we chose to concentrate on 2020 since Refinitiv restated their data in April 2020 in a way that made it historically more highly linked with returns (Berg et al., 2021). The final sample, constituted by energy European listed companies with all financial and ESG data available on Refinitiv, is made up of 50 companies. We have considered 50 DMUs, two input variables (Total Assets and

Total Equity), three output variables (EBITDA, Revenues and ESG scores). The credit exposure has been considered as 20% of the total debt of the company.

All the variables identified in the previous section have been extracted from Refinitiv Eikon ASSET 4.

5 Empirical results and discussion

In this section, the results and discussion are described. Various experiments were carried out in order to test the correlation between ESG and financial reliability, intended as either ratings or default probability. In particular, our results do not show the existence of a relationship between ESG scores and financial reliability. The correlation coefficient between efficiency values, calculated taking into account ESG scores, and credit ratings and PD, is around values very close to zero (0.0026 and 0.0725). This is in line with recent studies on the impact between ESG activities and corporate performance, which emphasize that an investment strategy linked to ESG factors does not significantly affect the profitability or value of the company in the energy sector (Adamkaite et al., 2022) or even found negative association between ESG performance and corporate financial performance in the oil and gas industry (Kaupke and zu Knyphausen-Aufseß, 2022). More generally, this trend line is also confirmed on other sectors, indeed Atan et al. (2018) conducting a panel study on Malaysian companies, not belonging to the energy sector, found no significant relationship between individual and combined factors of ESG and firm profitability (i.e., ROE) as well as firm value (i.e., Tobin's Q). Even in the utilities sector, the study by Veltri et al. (2023) does not find a significant relationship between ESGs and financial performance.

Table 2 shows the correlation coefficients, together with the ESG value for each DMU, and the efficiency results with and without ESG. As we can observe, for those companies with high ESG scores (ESG score > 80), the efficiency score remains the same whether ESG factors are considered, or they are excluded from the efficiency evaluation. Furthermore, on 10 companies in the sample with higher ESG scores and low efficiency, 8 of them are characterized by having higher debts than their peers, despite having similar equity values. This is expressive of an unbalanced financial structure, which could have been caused by an overinvestment in ESG, consistently with the overinvestment theory (Azmi et al., 2021; Di Tommaso and Thornton, 2020). For those companies with high ESG

scores (ESG score > 80) and good financial efficiency score, the combined efficiency score remains the same whatever the ESG factors are considered or are excluded from the efficiency score.

Table 2 – Efficiency scores with and without ESG

DMU	ESG	Efficiency without ESG	Efficiency with ESG	PD	Rating
dm1	56.91	0.358	0.709	1.687%	6.00
dm2	72.03	0.707	0.824	0.512%	3.00
dm3	85.53	0.353	0.353	0.280%	11.00
dm4	76.49	0.483	0.626	1.333%	3.00
dm5	25.26	1.000	1.000	0.208%	10.00
dm6	83.46	0.384	0.384	0.714%	11.00
dm7	81.20	0.459	0.459	0.311%	10.00
dm8	43.55	1.000	1.000	0.415%	2.00
dm9	81.39	0.559	0.559	0.212%	6.00
dm10	52.99	0.196	0.569	0.290%	5.00
dm11	55.82	0.939	0.993	1.912%	6.00
dm12	73.77	0.604	0.823	0.265%	8.00
dm13	76.78	0.805	0.805	0.396%	9.00
dm14	62.28	0.419	0.419	0.344%	2.00
dm15	59.61	0.25	0.25	0.226%	6.00
dm16	56.95	0.208	0.415	0.335%	14.00
dm17	40.11	0.568	0.568	0.179%	11.00
dm18	58.27	1.000	1.000	0.631%	8.00
dm19	44.44	0.325	0.658	0.500%	14.00
dm20	56.61	0.497	0.497	2.374%	6.00
dm21	67.21	0.409	0.439	0.250%	10.00
dm22	64.78	0.594	0.594	0.207%	11.00
dm23	68.33	1.000	1.000	1.186%	9.00
dm24	70.77	1.000	1.000	0.118%	15.00
dm25	79.21	0.679	0.679	0.302%	7.00
dm26	77.21	0.414	0.414	1.367%	3.00
dm27	64.36	0.315	0.318	0.082%	11.00
dm28	81.09	0.486	0.486	0.241%	11.00
dm29	69.81	1.000	1.000	1.046%	12.00
dm30	61.56	0.610	0.913	2.970%	5.00
dm31	48.64	0.526	1.000	0.321%	7.00
dm32	61.93	0.626	0.626	0.422%	11.00
dm33	49.23	0.568	0.568	0.185%	15.00
dm34	82.45	0.486	0.486	0.169%	10.00
dm35	70.20	0.58	0.626	0.503%	14.00
dm36	89.35	0.537	0.537	2.540%	8.00
dm37	69.33	0.535	0.559	0.453%	9.00
dm38	47.40	0.434	0.466	0.914%	8.00
dm39	88.52	0.436	0.436	0.255%	11.00
dm40	68.50	0.359	0.359	2.991%	7.00

dm41	88.84	0.403	0.403	0.306%	12.00
dm42	75.93	0.382	0.382	0.237%	5.00
dm43	46.49	0.603	0.603	0.318%	13.00
dm44	67.48	0.270	0.288	0.604%	8.00
dm45	68.30	0.556	0.730	0.178%	9.00
dm46	61.67	0.631	0.779	0.725%	9.00
dm47	90.07	0.421	0.421	0.203%	10.00
dm48	47.25	0.615	0.615	0.186%	9.00
dm49	54.48	0.253	0.257	1.374%	3.00
dm50	79.24	0.705	0.705	0.268%	15.00
Correlation coefficient		0.358	0.709	0.0026	*0.0725*

As it can be seen from Table 3, the model selects 10 out of 50 companies, which saturate the budget risk of the bank. They represent those companies for which the impact of the ESG score significantly improves the efficiency value calculated by taking into account only financial variables.

Table 3 – The selected efficient companies

DMU	**ESG**	**Efficiency combined model without ESG**	**Efficiency combined model without ESG**
dm1	56.91	0.514	0.873
dm2	72.03		
dm3	85.53		
dm4	76.49		
dm5	25.26	1.000	1.000
dm6	83.46		
dm7	81.20		
dm8	43.55	1.000	1.000
dm9	81.39		
dm10	52.99		
dm11	55.82		
dm12	73.77	0.825	1.000
dm13	76.78		
dm14	62.28		
dm15	59.61		
dm16	56.95		
dm17	40.11		
dm18	58.27		
dm19	44.44	0.470	0.803
dm20	56.61		
dm21	67.21		
dm22	64.78		
dm23	68.33		
dm24	70.77	1.000	1.000
dm25	79.21		

dm26	77.21		
dm27	64.36		
dm28	81.09		
dm29	69.81		
dm30	61.56		
dm31	48.64	0.526	1.000
dm32	61.93		
dm33	49.23		
dm34	82.45		
dm35	70.20		
dm36	89.35		
dm37	69.33		
dm38	47.40		
dm39	88.52		
dm40	68.50		
dm41	88.84		
dm42	75.93		
dm43	46.49		
dm44	67.48		
dm45	68.30	0.556	0.730
dm46	61.67	0.631	0.779
dm47	90.07		
dm48	47.25		
dm49	54.48		
dm50	79.24	1.000	1.000

Among these 10 companies, 4 maintain high efficiency scores both with and without ESG, meaning that if a company is already financially efficient, the ESG does not impact on the overall efficiency. In addition, we can notice that the ESG score of the six remaining selected companies does not have a very high value, instead they record a moderate ESG value.

Our results do not provide evidence of a strong significance of ESG factors in affecting firms efficiency. In detail, our results, consistently with the findings of Xie et al. (2019), show that high/low ESG scores do not affect the company efficiency, which is the same with or without ESG scores; instead at a moderate level (going from 44.44 to 77.21, table 2), ESG scores improve the corporate efficiency. In other words, ESG factors have a positive effect on firm corporate efficiency only at medium level. In a similar vein, other studies highlighted a weak link between ESG and corporate performance/risk (Di Tommaso and Thornton, 2020). Theoretically speaking, our results are in line with the overinvestment theory, according to which ESG may have detracted from companies' value by diverting scarce resources out of investment. Also, they are also consistent with the *window dressing theory* (Palazzo and Richter, 2005), according to which investors may be

"deceived" by communication about a company's pursuit of ESG criteria that, in reality, is very different from what is communicated. This leads investors to perceive ESG companies as riskier (Landi et al., 2022).

6 Conclusions

Within the banking sector, there is a growing awareness of the need to integrate ESG dimensions into strategies, processes, and financial instruments to generate long-term value, which is strongly influenced by non-financial factors, such as reputation, and stakeholder engagement, and customer value (Zumente et al., 2021). Financial institutions have recently started taking steps to cut back on funding for projects that hurt the environment after realizing how their lending and investing activities impact the condition of the world. By recognizing ESG principles and incorporating them into their strategies, banks can contribute to the development of a sustainable financial system. Our research intends to investigate whether the focus on ESG issues, embedded in loan management, has an impact on bank risk. In addressing this research question, we answer a call for a specific future direction identified by a recent bibliometric analysis of ESG performance in the banking industry (Galletta et al., 2022), namely "How will the ESG criteria enter the creditworthiness assessment process?". To the best of our knowledge, only the study of Brogi et al. (2022) posed our same research question, that is, if including ESG factors in the creditworthiness risk assessment mitigates the lending risk for the bank. Differently from theirs, we focus on a specific sector, as recent research provided evidence that it is not possible to assess a unique intensity and direction of the relationship between ESG and the firm performance/risk for all sectors (Pacelli et al., 2022). More specifically, we decided to focus on an environmental sensitive industry: the energy sector (i.e., oil and gas companies), as companies belonging to this industry are subjected to intense social and environmental scrutiny because of the nature of their activities (Galletta and Mazzù, 2022). In particular, focusing on the energy sector from a banking creditworthiness point of view seems important, as lending to extractive industries, such as oil, gas and mining, has always entailed significant operational, credit and political risks. Now climate change is exacerbating these risks – while adding reputational risk to the mix as banks face greater scrutiny of the environmental impact of their lending operations (BCBS, 2021).

Our results do not provide evidence of a strong significance of ESG factors in affecting firms' efficiency. Also, other empirical studies provided evidence of a weak link between ESG scores in energy sector and returns (Pacelli et al., 2022; Yoon et al., 2018). Our results, providing evidence that moderate ESG performance improves the overall firm performance, can incentivize firms management to increase ESG engagement (at least until a threshold point). In addition to the benefits for the firm, this incentive can lead to significant positive externalities to the environment in which the firm is embedded. As for the limits of our research, a first issue may be related to a sample selection bias because we only selected large listed firms operating in the Energy sector. We focus on large listed firms to rely on a high number of observations, as to the best our knowledge, there is no accessible data warehouse containing ESG data. Further research can be conducted in other industrial settings, such as the SME environment. Another limit is related to the subjectivity of the variables selected to measure the firm performance, even if this has not to be considered as a big limitation considering that the DEA methodology is a "non-parametric" technique. Future research could be devoted to testing the robustness of our results by using different input and output measures and different budget risk levels for the constraint. Furthermore, given the consideration that ESG scores vary greatly from one rating agency to another (Widyawati, 2020), future research could compare different ESG scoring methods by using a data provider other than Refinitiv and could also conduct further analyses to identify the dominant sub-factor in the relation of ESG on financial performance/financial risk analyzing separately the impact of the three pillars of ESG (Giese et al., 2021; Xie et al., 2019). In addition, future research could consider changing the methodology employed to investigate the hypothesized association or to analyze the association from a point of view different from bank managers such as financial analyst (Luo and Wu, 2022), portfolio managers (Pacelli et al., 2022) rated firms (Clementino and Perkins (2021), investors (Kiesel and Lucke, 2019). In this paper, we used ESG data from Refinitiv, a key ESG rating provider and an influential one; nevertheless, given the concerns related to the widespread corporate practice of 'greenwashing', that is, the well-known phenomenon of disseminating information that is false or incomplete about environmental, social and governance factors (Pacelli et al., 2022), to increase the reliability of information, a future research direction could include ESG controversies in the model, as ESG controversies are not controlled by firms and, hence, represent an effective indicator to express the market

perception of firms real compliance with ESG criteria (Galletta and Mazzù, 2022). Another future research could be to analyze whether considering ESG as an additional criterion in selecting firms to fund is conditional on board of directors' characteristics (Di Tommaso and Thornton, 2020; Burke, 2022). We believe that the introduction in the credit risk assessment of ESG factors is an extremely important issue to investigate, as policy makers and regulators are posing the sustainable lending objective high in their agenda, and our results, adding new knowledge on the issue of the integration of ESG factors in the creditworthiness analysis of borrowers, offer suggestions regarding the inclusion of the ESG issue as a potential credit risk mitigation factor in the eyes of credit managers, investors and regulators. As for the policy implications, the consideration that the weak link between ESG scores and firm performance could be linked to an increasing amount of extra non-univocal financial information on the markets, such as sustainability reports or ESG ratings, poses a fundamental issue in terms of regulation. New and effective regulations for ESG reporting and metrics are needed to guarantee reliability to stakeholders, enabling the exploitation of this additional information without the social and greenwashing phenomena. Policy actions have to aim at making non-financial communications more transparent for investors and at providing companies with generalized and unambiguous indications for reporting on ESGs (La Torre et al. 2021).

As for the research implications, considering that ESG issues have not yet been studied sufficiently from a risk perspective, future research could focus on designing a new risk management framework for tackling ESG risks. Furthermore, future research could investigate the association between ESG merit and systemic risk (Bax et al., 2022).

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How Digital Transformation May Optimize the Utilization of Healthcare Services: The Case of Italian Screening Programs

Luigi Jesus Basile*

Polytechnic University of Bari
Department of Mechanics, Mathematics and Management
Via Edoardo Orabona, 4, 70125 Bari BA

Nunzia Carbonara

Polytechnic University of Bari
Department of Mechanics, Mathematics and Management
Via Edoardo Orabona, 4, 70125 Bari BA

Umberto Panniello

Polytechnic University of Bari
Department of Mechanics, Mathematics and Management
Via Edoardo Orabona, 4, 70125 Bari BA

Roberta Pellegrino

Polytechnic University of Bari
Department of Mechanics, Mathematics and Management
Via Edoardo Orabona, 4, 70125 Bari BA

* *Corresponding author*

Abstract

Digital transformation is revolutionizing the healthcare industry, and the use of digital technologies is generating large amounts of data that can be used to support the healthcare decision-making process. The use of data leads to several improvements in healthcare, such as treatment selection or diagnosis process. The utilization of healthcare services is one of the prominent topics in healthcare, but it is still in its infancy in the digital transformation literature. This study aims to investigate the use of big data analytics to improve the utilization of healthcare services, specifically the Italian national cancer screening programs, through a two-step methodology. First, we investigate the relationship between patient characteristics and the utilization of the healthcare services

under consideration. In the second step, the collected data are used to build a data-driven model to identify patients who are more likely not to use healthcare services based on their characteristics. This study contributes to the existing literature on digital transformation in healthcare by proposing a data-driven model to improve healthcare service utilization. While we contribute to the practitioner perspective by proposing a real-world data-driven methodology that overcomes the disadvantages of the most common methods to identify patients that will not utilise healthcare services (i.e., survey-based methods).

Keywords – Digital transformation, healthcare service, decision making, big data

Paper type – Academic Research Paper

1 Introduction

Digital transformation is shaping the future of organizations in many industries (Hanelt et al., 2021). Gong and Ribiere (2021) defined it as "a fundamental change process enabled by digital technologies that aim to bring radical improvement and innovation to an entity (e.g., an organization, a business network, an industry, or society) to create value for its stakeholders by strategically leveraging its key resources and capabilities". The adoption and proper use of digital technologies have many positive impacts on organizations (Gaglio et al., 2022). These range from improved productivity and efficiency, through the automation of activities, to the creation of new business opportunities (Hanelt et al., 2021; Kraus, Jones, et al., 2021). Moreover, the adoption and use of digital technologies are opening up new ways to further improve the performance of organizations. In this regard, digital technologies generate a large amount of data that can be exploited to extract insightful information to support decisions in different domains (Aceto et al., 2020; Chen et al., 2012). One important trend of digital transformation is the increasing use of big data analytics to analyze large amounts of data and generate these insights (Ashaari et al., 2021; Wang et al., 2018). The major beneficiaries of this breakthrough are those industries characterized by highly complex decision-making processes with uncertain outcomes, certainly including the healthcare industry. The healthcare industry is characterized by highly complex and uncertain decisions, whose outcome is influenced by multiple and different variables and issues, such as the complexity of the patient's disease and the involvement of various actors in the decision-making process, e.g., physicians, families, and patients (Han et al., 2019; Kraus, Schiavone, et al., 2021). As such, the

healthcare industry can gain great advantages from digital transformation and in particular through the use and exploitation of big data. In the academic literature, the use of big data analytics in healthcare has been widely investigated for delivering personalized care, supporting the diagnosis or treatment selection, identifying patients at risk of developing a disease and improving the use of resources (Galetsi & Katsaliaki, 2020; Kraus, Schiavone, et al., 2021). Despite the growing literature on the use of big data analytics to support decision-making in healthcare, it is clear that it has not yet reached its full potential and there is still room for further investigation (Galetsi & Katsaliaki, 2020). In this regard, the potentiality of big data analytics for improving the utilization of healthcare services is a promising topic (Dal Mas et al., 2023; Hu et al., 2021; LaVeist et al., 2009) and at the same time, it seems to be overlooked by the literature about digital transformation in healthcare. Underutilization of healthcare services refers to the unwillingness to use a healthcare service that has the potential to improve the patient's quantity and quality of life (Elshaug et al., 2017). The underutilization of healthcare services can be due to contingency factors, such as financial barriers, and the patient's characteristics, such as lack of knowledge, lack of awareness, and risk attitude (Glasziou et al.; 2017).

A pivotal example of the underutilization of healthcare services regards the screening programs aimed at preventing and detecting diseases at an early stage. Data on the screening programmes for breast, cervical, and colorectal cancer provided by the Italian national healthcare system (NHS) in the 2019 campaigns show that only 60.7%, 39.1%, and 41.6% respectively, of the target population, access to these services (ONS, 2020). Since the screening programs are free of charge for all the citizens who are in the at-risk age group, the patients' characteristics can be considered as a main explanatory factor of the underutilization of these healthcare services.

Therefore, healthcare policymakers need to take into account these characteristics to understand how a patient will act with respect to using a healthcare service and to develop strategies to lead the patient's behaviour towards optimal choices. However, acquiring information about these characteristics is a big challenge. In fact, it requires interviewing individuals through questionnaires, which makes this information difficult to be exploited as the process would be costly and time-consuming (Houston et al., 2021; Regmi et al., 2016). In this regard, digital transformation can support healthcare

policymakers by enabling the extraction of information about the patients' characteristics in real-time without any relevant additional costs.

Despite this topic seems promising to support healthcare policymakers, to the best of the authors' knowledge, the use of data to improve the utilization of healthcare services seems overlooked by academic literature. Pursued by this research gap, this study investigates how big data analytics could support policymakers in optimising the utilization of healthcare services. Consequently, this study seeks to answer the following research question:

> *How can big data analytics support healthcare policymakers in increasing the utilization of healthcare services?*

Aiming to answer the research question we developed a methodology consisting of two steps. In the first step the relationship between patients' characteristics and utilization of healthcare services has been deeply investigated in the academic literature, and a survey has been developed and administered. In the second step, the data collected in the first step are used to build a big data analytics model to classify patient characteristics that lead to underutilization of healthcare resources. The remainder of this paper is structured as follows: section 2 describes the theoretical background. Section 3 presents the research design and the methodology. Section 4 presents the results, and section 5 discusses the results before concluding with limitations and future research avenues.

2 Theoretical background

2.1 Digital transformation and big data analytics in healthcare

One of the main beneficiaries of digital transformation is the healthcare industry (Baudier et al., 2022; Kraus, Schiavone, et al., 2021). Technology concepts such as big data, the Internet of Things and cloud processing are driving this sector towards 'Healthcare 4.0' (Aceto et al., 2020). Wearable and portable devices, telemedicine and electronic health records are some of the most widely used technologies in healthcare (Marques & Ferreira, 2020). Digital technologies are characterized by their ability to generate and collect large amounts of data (i.e. big data) (Dal Mas et al., 2023; Kraus, Schiavone, et al., 2021). The availability of these data provides an opportunity to extract information and, if used correctly, provide decision support (Basile et al., 2023; Weerasinghe et al., 2022). The information is extracted through big data analytics (BDA). BDA refers to

technologies, processes, and methods that evaluate large amounts of data to help an organisation make more informed, critical decisions (Wang et al., 2018). Big data can come in different formats, for example, images or X-rays, structured datasets, and medical records, and to eventually get data analytics there are several algorithms and techniques to extract meaningful information (Chen et al., 2012; Dicuonzo et al., 2022; McAfee et al., 2012). Big data analytics can have an impact on several domains of healthcare. Disease surveillance is one of the domains addressed by the big data analytics literature. For example, BDA can be used to ensure a rapid reaction to disease outbreaks, for instance, to identify the need for new vaccines (Abdel-Basset et al., 2021; Baudier et al., 2022). Another prominent topic is the use of BDA in disease management. In this regard, BDA can support the physicians' decisions to identify patients at risk, and for diagnosis and treatment selection (Bukhari et al., 2021; Chi et al., 2022; Eletter et al., 2021). Moreover, the use of BDA has also proven successful in improving healthcare processes in terms of organizational performance by assessing resource efficiency, tracking workload, and reducing human error (Augustin et al., 2022; Demir, 2014; K. Zhu et al., 2015). Considering the utilization of healthcare services, the academic literature focused mainly on how to ensure basic healthcare services and the continuity of care by using data collected through telemedicine and wearable technologies (Cannavacciuolo et al., 2022; Khodadad-Saryazdi, 2021; Wu et al., 2016). Telemedicine allows patients to communicate with healthcare professionals remotely via videoconferencing or other digital platforms, while wearable and portable devices enable remote tools to monitor patient health data. However, the current focus seems to be on overcoming issues such as the inaccessibility of services by delivering services remotely through the use of digital technologies, rather than using big data analytics to increase the use of healthcare services (e.g., screening and prevention programmes). To the best of our knowledge, no work has proven whether the use of BDA to support healthcare policymakers' decision-making process can lead to an increase in the utilization of healthcare services. This paper aims at contributing to the academic literature about the use of big data analytics in healthcare by filling this gap.

2.2 Utilization of healthcare services and risk attitude

The main causes of underutilization of healthcare services can be outlined in inadequate access, healthcare system failures, physicians' decisions and

competencies in delivering care, and patient's behaviour (Glasziou et al., 2017). These aspects have been widely studied in the literature (Elshaug et al., 2017; Saini et al., 2017; Titaley et al., 2010). Among others, the patients' risk attitude (RA) is considered a key determinant of the decision-making process and a leading cause of patients' behaviour in healthcare (Lutter et al., 2019; Zhu et al., 2020). RA can be defined as the individual's characteristic that explains the willingness of people to prefer decisions with lower or higher risk, depending on whether they are risk-averse or risk-seeking, respectively (Weber, 2010). According to the scientific literature, RA may also change over time, for instance, as people ages, they may become more risk-averse (Massin et al., 2018; Prosser et al., 2002; Rosen et al., 2003). In this context, the information about an individual's RA could support the healthcare professionals' decision-making. For example, physicians could use the patients' RA to identify patients that need to be encouraged in treatment adherence (Zhu et al., 2020). Moreover, it is possible to inform healthcare policymakers to properly design vaccine campaigns considering patients' RA since risk-averse patients tend to avoid vaccination (Diza et al., 2022). In accordance with these results, Lutter et al. (2019) found that "risk-seeking" patients have lower odds of attending medical check-ups. The most used methods to measure RA are questionnaire-based: lotteries, assessment of hypothetical or actual behaviour and self-reports based on situational questions and rating scales (Lutter et al., 2019; Weber, 2010). These methods have several limitations including the administration and answer time, patients may not be interested in filling them out also due to their attributes (including RA), and finally considering the changing nature of RA in individuals the answer to a questionnaire may no longer be valid a short time later. In this paper, following the academic literature, we maintain that RA is a relevant patient characteristic that can inform healthcare policymakers about healthcare utilization. However, current measurement methods do not enable easy measurement of risk attitude and therefore its use. Despite the availability of data (e.g., electronic health records) and the spreading of big data analytics, academic literature did not explore the potential of big data analytics in improving the utilization of healthcare services through the use of patient characteristics (i.e., risk attitude).

3 Methodology

In this research project, we investigated whether the use of information about the patient's risk attitude obtained through the use of big data analytics could support the healthcare policymakers' decision-making in increasing the utilization of healthcare services, and the research methodology is based on the Design Science Research Methodology (DSRM) (Peffers et al., 2007), since this methodology supports researchers in addressing both practice-driven and research-driven goals (Hevner et al., 2004). Moreover, this methodology support researchers to implement "artefacts" based on digital technologies to support healthcare decision-makers, e.g. to support physicians in treatment selection (Basile et al., 2021) and for disease assessment and monitoring (Casal-Guisande et al., 2020). The process of the DSRM consists of six steps (Peffers et al., 2007). The first step is devoted to the identification and definition of the problem. The second step includes the definition of the research's goals. The third step provides the design and development of the artefact. The fourth step is focused to demonstrate how the model can solve the problem identified in the first step. The last steps are the evaluation of the proposed solution and the communication of the objectives and performance reached by the proposed artefact.

3.1 Identification of the problem

In the current era, technological and medical advancement is driving an increase in average life expectancy. The ageing of the world's population is increasing and it is bringing out more and more diseases related to genetics and lifestyles (WHO, 2022). In this context, cancer is the second leading cause of death, accounting for roughly 10 million deaths in 2020 (Ferlay et al., 2020), consequently, it represents a significant social and economic burden in all countries, reflecting premature mortality, morbidity and high healthcare expenditures. As the cost of cancer care increases, attempts to prevent and detect cancer at an early stage through screening programmes become more and more relevant (Abati et al., 2020; Xi & Xu, 2021). Despite their relevance, the screening programs are underutilized healthcare services (Baird, 2022; Nuche-Berenguer & Sakellariou, 2019). The underutilization can be determined by financial issues, lack of awareness and patients' behavioral characteristics (Glasziou et al., 2017). In this research project, we considered the screening programme for breast, cervical and colorectal cancer provided by the Italian national healthcare system (NHS) for

three reasons. Firstly, the Italian NHS provides these healthcare services free of charge for all the citizens who are in the at-risk age group (i.e., women that are 50-69 for breast cancer, women that are 25-64 for cervical cancer and women and men that are 50-69 for colorectal cancer), as a result in the Italian case the financial barrier to access healthcare services can be excluded from the causes of underutilization (ONS, 2020). Secondly, the Italian NHS has for many years been committed to campaigns to raise awareness of the importance of screening, so it is reasonable to assume that the lack of awareness among its citizens has diminished over the years. Third, despite the efforts of the Italian NHS, the utilization of these services is still low and has considerable room for improvement (ONS, 2020). Therefore, the case of the Italian NHS can provide the proper context to investigate whether the use of big data analytics to identify patients at risk of not participating in screening programs due to their behavioural characteristics (i.e., risk attitude) can support the policymakers' decision-making process leading to an improvement of the healthcare utilization.

3.2 Definition of the objectives

This study aims to investigate the use of big data analytics to improve the utilization of healthcare services, specifically the utilization of screening programmes in Italy. Therefore, firstly this study investigates the utilization of breast, cervical and colorectal cancer screening programmes and the role of patients' risk attitude in the use of these services. Secondly, we investigate the potential of big data analytics in informing policymakers and healthcare policymakers about the patient's risk attitude in order to enable data-driven decision-making to improve the utilization of healthcare services.

3.3 Design and development of the artefact

Aiming to answer the research question and achieve the research project's goal we designed and tested a decision support model following two steps. In the first step, we developed and administered a survey to investigate the relationship between patient characteristics and utilization of the healthcare services under consideration. In the second stage through a process of big data analytics, a model will be defined to predict the risk attitude of patients with respect to their

characteristics collected in the first step. This paper presents the results of the investigation of patient characteristics and utilization of healthcare services.

3.4 Demonstration

The information collected through the survey will be used to build a model that compares the performance of screening programs in terms of costs and time savings in three scenarios: the real scenario (baseline), the scenario in which healthcare policymakers use the risk attitude information from the questionnaire (first scenario) and the scenario in which they use the risk attitude information extracted through the model. The demonstration of the effectiveness of the model will be carried out by means of Monte Carlo simulations under the three reference scenarios.

3.5 Evaluation and Communication

The evaluation will be carried out by analysing the results of the proposed model in the three scenarios in terms of utilization of healthcare services utilization and costs. As for communication, the model will be implemented to be used in a real case. To this aim, a pilot project in a hospital would be carried out.

4 Results

To collect information about patients and investigate the relationship between patients' risk attitude and screening programme utilization we developed a survey consisting of three sections. In the first section, the questions aim to assess the risk attitude of respondents through a self-assessment question and the DOSPERT scale (Blais and Weber, 2006). We selected these assessment methodologies because they are considered among the most reliable for the assessment of respondents' risk attitudes (Lutter et al., 2019). In particular, we considered only the health and general domains of the DOSPERT scale since the academic literature highlights the need to measure risk attitudes in the area where the decision-makers have to make the decision (Rosen et al., 2003; Weber, 2010). Considering the DOSPERT scale, the survey developed in this research project investigates the patient's risk attitude in two domains. The first is the general domain in which the respondents were asked general questions about their willingness to take risks in the situation as the betting of their salary in

different scenarios. The second is the health domain, where the respondents were asked to indicate their preference in engaging in risky activities for their health such as not carrying a helmet on a motorcycle or not using sunscreen when they are sunbathing. In the second section, the survey aims to collect respondents' personal information that are at the same time available in hospital electronic health records and which, according to the scientific literature, are related to risk attitudes. For instance, we collected data about their age, gender, height and general health status. Finally, in the third section, we investigated the current use of healthcare services and in particular of cancer screening programs under investigation. Table 1 shows the sections and questions of the survey.

Table 1 The survey

Section	Item	References
Risk Attitude	In general, in the different domains of your daily life, where do you situate yourself between 0 and 7, where 0 means "not at all willing to take risks" and 7 means "fully prepared to take risks"?	Lutter et al., 2019
	Admitting that your tastes are different from those of a friend.	DOSPERT (Blais and Weber, 2006)
	Betting a day's income at the horse races.	
	Drinking heavily at a social function.	
	Disagreeing with an authority figure on a major issue.	
	Betting a day's income at a high-stakes poker game.	
	Betting a day's income on the outcome of a sporting event	
	Engaging in unprotected sex.	
	Driving a car without wearing a seat belt.	
	Riding a motorcycle without a helmet.	
	Sunbathing without sunscreen.	
	Walking home alone at night in an unsafe area of town.	
Respondents' Characteristics	What is your age?	(Arrieta et al., 2017; Dohmen et al., 2011; Lutter et al., 2019; Massin et al., 2018; Prosser et al., 2002; Rosen et al., 2003; Weber, 2010; J. Zhu et al., 2020)
	What is your gender?	
	How tall are you?	
	How much do you weigh?	
	What is your city of residence?	
	Are you married?	
	Are you divorced?	
	Are you widowed?	
	Do you have children?	
	How many children do you have?	
	How old is your youngest child?	
	What is your educational qualification?	

	Are you a smoker?	
	What is your occupation?	
	How would you define your general health status?	
	Has one or more of the following diagnosed chronic conditions: [ALS (Lou Gehrig's disease); Alzheimer's disease or other dementias; Arthritis; Asthma; Cancer; Chronic obstructive pulmonary disease (COPD); Crohn's disease, ulcerative colitis or another inflammatory bowel disease; Cystic fibrosis; Diabetes; Eating disorders; Cardiovascular disease; Obesity; Osteoporosis]	
	Have you ever had surgery?	
	How long ago did you have the most recent surgery?	
	Are you taking any drug therapy (excluding dietary supplements)?	
Healthcare services utilization	When you had your last visit	Lutter et al., 2019; Dohmen et al., 2011
	When did you have your last checkup?	
	Have you ever participated in a screening program?	
	Have you ever participated in a breast cancer screening program?	
	Have you ever participated in a cervical cancer screening program?	
	Have you ever participated in a colorectal cancer screening program?	

5 Conclusion

Digital transformation is reshaping the activities in several industries, and healthcare is considered one of the most beneficiaries. The use of digital technologies produces several data that can be exploited to support the decision-making process in healthcare. In this regard, the underutilization of healthcare services is one of the most discussed topics in healthcare, and the academic literature point out several causes of underutilization. The patients' behaviour decision-making is considered one of the main causes and it can be caused by patients' characteristics (i.e., risk attitude). However, the use of data for the identification of patients who will not use healthcare services is an under-investigated topic in the literature on data-driven digital transformation. Therefore, this study examines the potential of data-driven decision-making in improving the utilization of healthcare services, and in particular, the Italian national cancer screening program, through a two-step methodology. In the first step, we investigated the relationship between risk attitude and patients' personal

information through a literature review and consequently, we developed a survey which was administered to potential users of the screening programme. While the second step concerns the development and testing of a data-driven model to identify patients who will not participate in the screening programme. This paper shows the results of the first step, by describing the survey developed. In this regard, the academic literature points out that there are several methods to measure the individual's risk attitude, but the self-assessment and the assessment of hypothetical or actual behaviour (i.e., DOSPERT scale) are considered the most reliable (Lutter et al., 2019; Massin et al., 2018). Moreover, we identified the patients' information that are related to the risk attitude according to the academic literature. The results presented in this paper contribute to both theory and practice. From a theoretical perspective, this paper contributes to the extant literature about data-driven decision-making in healthcare by proposing the use of big data analytics to improve the utilization of healthcare services. While we contribute to the practitioners' perspective by proposing a data-driven methodology to exploit the information about patients' risk attitudes that overcomes the disadvantages of the most common measurement methodologies that are survey-based. Despite the relevance and potential of this topic, researchers and practitioners must consider that patients' data privacy is of paramount importance. In the current years, artificial intelligence (AI) and machine learning open up several opportunities for automated decision-making that at the same time raised relevant concerns about the use of these tools. Therefore, it is crucial to develop ethical guidelines and regulations that ensure the responsible use of AI and machine learning in healthcare, protecting patients' privacy while harnessing the benefits of these technologies. Additionally, educating healthcare professionals and patients about the implications of AI and machine learning in healthcare can foster a better understanding of these tools' potential and limitations. Though, in this paper, we did not propose a model for automated decision-making but only data-driven tools to support healthcare policymakers' decision-making. Thus, since we maintain a human direct intervention in the decision-making process the issues related to automated decision-making are not a primary concern of this study. Despite this, in accordance with Art. 22 of the General Data Protection Regulation (GDPR) (art. 22 GDPR, 2018), the proposed model could only be used for patients who have authorized healthcare organizations to use their personal information.

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Organizations' Sustainability-Oriented Innovation: When Open Innovation Leads to Sustainability

Irene Fulco*

Department of Economics, Engineering, Society and Business Organization
University of Tuscia of Viterbo
Via del Paradiso, 47, 01100 – Viterbo, Italy

Francesca Loia

Department of Economics, Management, and Business Law
University of Bari Aldo Moro
Largo Abbazia Santa Scolastica, 53, 70124 – Bari, Italy

Barbara Aquilani

Department of Economics, Engineering, Society and Business Organization
University of Tuscia of Viterbo
Via del Paradiso, 47, 01100 – Viterbo, Italy

Paola Adinolfi

Department of Management & Innovation Systems
University of Salerno
Via Giovanni Paolo II, 132, 84084 – Fisciano, Salerno, Italy

** Corresponding author*

Abstract

This paper is intended as a contribution to the ongoing conceptual development of the role of organizations in fostering innovation, and in promoting, at the same time, sustainability. In particular, Sustainability-oriented innovation (SOI) involves making intentional changes to an organization's philosophy and values, in terms of "openness", which consider commercial viability, while simultaneously improving environmental and/or social performance. However, although it is evident how essential it is to ensure a SOI within organizations, little attention has been paid to bridging between open innovation (OI) and sustainability, with particular references to the key drivers enabling such valuable processes within organizations. Starting from these considerations, the main purpose of

this paper is to contribute to the recent debate on the new intersection between innovation and sustainability within organizations. The paper, focusing on Enel case study and through a website content analysis, sheds light on the drivers related to the concept of "open innovability". The study offers several useful implications for both researchers and professionals operating in the sustainable innovation field, highlighting how OI could support the organization in the creation and transmission of sustainability solutions and objectives.

Keywords – open innovation, sustainability, sustainability-oriented innovation, content analysis.

Paper type – Academic Research Paper

1 Introduction

As a result of globalization, technological complexity, increased competition and resource scarcity, organizations have had to adopt a more open, cooperative approach to building their competitive advantage (Barrett et al., 2021). The concept of Open Innovation (OI) has thus enjoyed increasing popularity in the recent scientific literature (Zhang et al., 2023).

However, its potential carried toward developing strategies and policies to solve complex sustainability issues has yet to be fully exploited (Kimpimäki et al., 2022).

Specifically, the literature on OI concerns knowledge transfer between the organization and third parties to support innovation activities (Chesbrough, 2003, 2006). On the other hand, the literature on sustainability suggests that companies should integrate mechanisms to serve the specific purpose of creating and realizing social and environmental value in addition to economic returns (González-Ramos et al., 2023).

In this direction, Sustainability-oriented innovation (SOI) (Adams et al., 2016; Rauter et al., 2017, 2019; Roszkowska-Menkes, 2018; Bogers et al., 2020; Melane-Lavado and Alvarez-Herranz, 2020; Gyamfi and Sein, 2021) involves making intentional changes to an organization's philosophy and values, which improve environmental and/or social performance while simultaneously considering commercial viability. The OI mindset (Engelsberger et al., 2022), conceptualised as a set of values, attitudes, and beliefs that capture an individual's openness towards knowledge sourcing and sharing inside and outside organisational boundaries, is critical for organisations engaging in OI practices. However,

although it is evident how essential it is to ensure a SOI within organizations, little attention has been paid to bridging between OI and sustainability, with particular references to the key drivers enabling such valuable processes within organizations.

Starting from these considerations, the main purpose of this paper is to contribute to the recent debate on the new intersection between innovation and sustainability within organizations. In particular, the work aims to identify important issues in supporting innovation processes and in creating better conditions to properly reach sustainability conditions. In particular, the study's originality lies in the attempt to bring out the conditions under which OI can lead to sustainability.

To meet this aim, this study is based on a qualitative investigation approach that follows the website content analysis (Hasim et al., 2018) of a valuable Italian multinational energy company and a leading global integrated operator in the electricity and gas sectors, shedding light on the drivers related to the concept of "open innovability". As a consequence, the study proposes new ideas regarding SOI, investigating how the proactiveness of some OI processes affects organizations' SOI.

The paper is structured as follows: Section 2 focuses on a literature review on OI and SOI. Section 3 illustrates the methodology used for the study. Section 4 provides the results and the discussion of the analysis. Finally, section 5 sets out conclusions, implications, limitations of the study, and future research agenda.

2 Literature review

2.1 Open Innovation

In a turbulent, hypercompetitive, and difficult to predict environment, such as the one we have been experiencing for years now, organizations have to face complex challenges in terms of coherent adaptation to the context in which they are embedded (Barrett et al., 2021). New paradigms, such as that of OI (Chesbrough, 2003, 2020; Chesbrough and Appleyard, 2007; Elmquist et al., 2009), could support organizations in the necessary change and improvement of their business models and practices and in the definition of successful strategic paths (Zhu et al., 2019). OI refers to "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using

pecuniary and non-pecuniary mechanisms in line with the organization's business model." (Chesbrough and Bogers, 2014, p. 17), thus describing how firms innovate by interacting with other organizations.

Specifically, Chesbrough (2003), in defining for the first time OI, stated that "valuable ideas can come from inside or outside the company and can go to market from inside to outside the company as well" (Chesbrough, 2003, p. 43; Chesbrough and Bogers, 2014), referring to the collaboration between the organization and third parties in the development of innovative products and services and in the sharing of risks and benefits of research, construction, implementation, and commercialization of new ideas (Chesbrough, 2003, 2006; Gatzweiler et al., 2017). This transition from a closed innovation to an OI paradigm - through inbound, outbound, and coupled processes (Gassmann et al., 2010) - could allow for mutual benefits; on the one hand, the organization can increase profitability through the pursuit of differentiation strategies, and the reduction of time-to-market, and, on the other hand, the external subjects involved can broaden their perspectives and seize new growth opportunities (Enkel et al., 2009).

Furthermore, closely connected to the concept of OI is the phenomenon of platformization - platforms as intermediaries for organizing processes of value creation and OI (Gawer and Cusumano, 2002, 2008; Gaver, 2014; Parker et al., 2016; Hagiu and Altman, 2017) – which has contributed to foster an increasingly interconnected environment, creating a system of relationships and collaborations between the organization and the outside that allows to exchange and/or share knowledge and skills in order to develop innovation and to solve OI challenges (Abbate et al., 2019, 2021).

The platforms, through the so-called "network effects" (Boudreau and Jeppesen, 2015), represent the genesis of real organizational ecosystem, a space created for co-evolution and strategic cooperation between parties, maximizing the capacity for knowledge exploration and exploitation (Dahlander and Gann, 2010; Huizingh, 2011).

2.2 Sustainability-Oriented Innovation

Recent developments in the sustainability domain, in the broader scope of the wider "triple bottom line" of economic prosperity, environmental protection, and social equity (Elkington, 1998, 2013) and in line with the Sustainable Development

Goals (SDGs) (Sadiq et al., 2023), suggest that companies should be open to mechanisms that can improve their innovation activities and capabilities, fully understanding how these practices connect to corporate strategy and socio-ecological system needs (González-Ramos et al., 2023). Some scholars have emphasized putting sustainability at the core of an organization's value creation activities (Ennals, 2010) and thus processes (Huber, 2008), reorganization of an organization's routines and structures (Rennings et al, 2006), and products and services (Hart, 1997; Maxwell and Van der Vorst, 2003; Albloushi et al., 2023). Consequently, innovation is perceived to play a key role in the area of corporate sustainability (Hart and Milstein, 2003; Zhou et al., 2020; Bahta, et al., 2021; de Oliveira et al., 2023) and SOI activities are increasingly acknowledged (Hockerts and Wüstenhagen, 2010; Hansen and Grosse-Dunker, 2012; Adams et al., 2016).

As Klewitz and Hansen (2014) have argued, "SOI describes a 'direction', which to follow requires the deliberate management of economic, social, and ecological aspects so that they become integrated into the design of new products, processes, and organizational structures" (p.57).

In particular, SOI (Adams et al., 2016; Rauter et al., 2017, 2019; Roszkowska-Menkes, 2018; Bogers et al., 2020; Melane-Lavado and Alvarez-Herranz, 2020; Gyamfi and Sein, 2021) envisages -through operational optimization, organizational transformation and systems building- merging OI practices with the sustainability concept (Arcese et al., 2015; Allal-Chérif et al., 2023), thus creating more sustainable production methods, market structures, and consumption patterns (Schaltegger and Wagner, 2011).

If an OI mindset was already critical for organizations engaging in OI practices (Engelsberger et al., 2022), it becomes even more central in SOI domain (Little et al., 2023).

Therefore, SOI practices require openness (van Oostrom and Fernandez-Esquinas, 2017), positive attitudes towards knowledge sharing and sourcing (von Briel and Recker, 2017), creativity (De Brentani, 2001), risk and failure tolerance (Mortara et al., 2010), as well as integrative complexity (Tadmor and Tetlock, 2006), on the part of the individuals involved, while respecting the organizational constraints and aligning with organization's business model (Ahn et al., 2017; Bogers et al., 2018; Rangus and Černe, 2019).

In this direction, OI and sustainability intertwine, developing a broader ecosystem (Du et al, 2014), so as to allow the exploitation and leverage of

complementary expertise and formulate a holistic solution that could have a long-lasting impact (Costa and Matias, 2020; Zhang et al., 2023).

3 Methodology

With the aim to contribute to the recent debate on the intersection between innovation and sustainability within organizations, this work performed the website analysis to gather information concerning the conditions under which OI can lead to sustainability. In the last 20 years, although relevant organizational information is usually communicated to stakeholders via annual reports, brochures, and newsletters, because of the increasingly widespread and pervasive use of Information and Communication Technologies (ICTs) and common acceptance of the internet as an 'organizational' tool for communication (Stevens et al., 2000), the website has been generally recognized as an organizational digital space useful to post relevant information (Adams and Frost, 2006). The increasing impact of digitalization has led to the richness of information on websites, also considered a useful tool for communicating organizational responsibilities. Zuo et al. (2012), in a study of 50 international contractors, found that almost 80% of the companies revealed their sustainability policies through their websites. In general, websites are often used to publicize information relating to organizational matters (Cober et al., 2003), sustainability practices (Da Giau et al., 2016;), as well information about innovative business processes (Wei, 2012). Therefore, this study follows a web content analysis as a legitimate research tool for indagating organizations' SOI, looking for the drivers closely related to OI and sustainability.

The content analysis explores the correlation between texts and possible themes or concepts (Jose and Lee, 2007) and it is most appropriate and well-accepted in social and environmental research (Nejati et al., 2011).

The case selected for this study is Enel, an Italian multinational manufacturer and distributor of electricity and gas. This company has been selected due to its huge impact on the global business landscape: in 2018, Enel has been recognized as the second largest power company in the world by revenue after the State Grid Corporation of China (IlSole24ore, 2022) and, during the 2021, it was the 73rd largest company in the world by revenue, with €88 billion (PowerTechnology, 2019). In particular, this sector has been selected, besides the strong environmental impact, because the literature highlighted the relevance of the

electricity and gas companies' websites for sharing information relating to sustainability practices (Insch, 2008). In particular, considering the strong relevance related to the research topic, we have selected and analysed Enel's website related to Open Innovability ® (https://openinnovability.enel.com), looking for the drivers of the latter.

The website has been manually reviewed. In particular, this technique was carried out by utilizing publicly available data, including any additional accessible relevant documents attached to the website. The analysis of the website considered the contents posted within the specific timeframe of 1 June to 1 December 2022, and it was conducted by typing specific words (Sustainability, Environment, Green, Innovation, Innovability) – the most commonly used descriptors on websites by organizations showing commitment to innovation and sustainability (Hasim et al., 2018) - to find target themes and key drivers related to the SOI.

In particular, as depicted in Figure 1, the flowchart for the content analysis of the selected website has been defined (Hasim et al., 2018). The detailed procedure was as follows:

1. The information was read numerous times, and relevant data sets were identified. These data sets were copied and pasted to the tables in a document. A detailed reading was carried out, and initial thoughts on SOI were noted in the specific column;
2. The relevant data were read again, and the initial notes were transformed into final themes and drivers that were significant and relevant to the research aim and objectives. Any unsuitable and unclear initial notes were excluded;
3. The data were read again for refinement of the themes into definite headings based on common practices and drivers related to SOI. For the purpose of this research, only the most common themes relevant to the research objectives were identified and chosen.

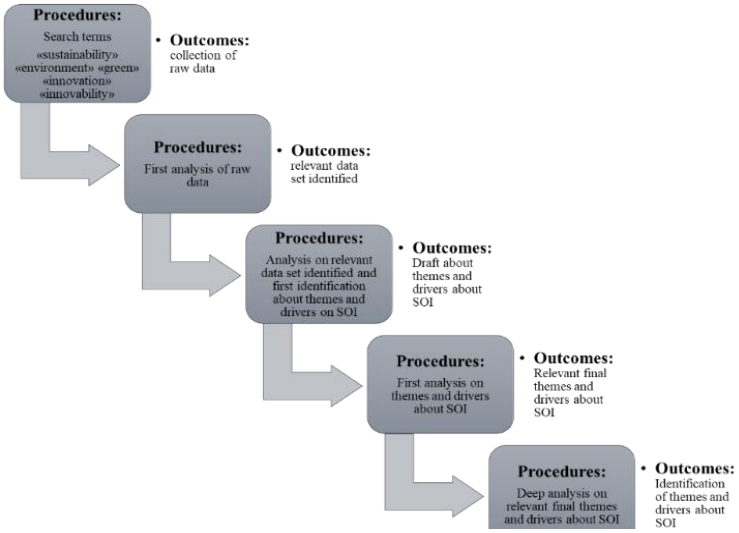

Figure 1 - Flowchart for content analysis on the website
Source: Authors' elaboration from Hasim et al. (2018)

4 Results and discussion

Enel Open Innovability ® can be described according to its definition, main activities, value proposition, methodology, partnership and collaboration, technological priorities, and relation to sustainable development goals (Table 1).

Table 1 - Enel Open Innovability ®: definition and characteristics

Enel Open Innovability ®	
Definition	Enel Open Innovability ® team, connected to the Enel group, is aimed to seek new business opportunities and is connected to the local ecosystem to identify the brightest solutions.
Activities	The activities are aimed to connect both digitally and physically with the ecosystem to build new solutions that address the world's most pressing and complex challenges.
Value proposition	The value proposition is based on leading energy transition through open collaboration with start-ups, SMEs, large companies, academics, internal and external experts, and investors.
Methodology	The methodology is based on the connection between OI and sustainability, which consists of crowdsourcing the best talent, ideas, and technologies to scale them up into disruptive business models.
Partnership and collaboration	The partners are: • Crowdsourcing partners (e.g. Wazoku, Agorize, Innovitalia, Desall); • Start-up ecosystem (e.g. Greentown Labs, Ecosummit, InnoEnergy, InnovUp); • Universities (e.g. Bocconi University, Venice International

	University, Polytechnic University of Turin, Columbia Climate School); • Corporate & international institutions (e.g. 3M, Novamont, Microsoft, Cisco, Intesa San Paolo Innovation Center); • Sustainability related actors (e.g. Human Foundation, Ashoka, Liter of Light).
Technological priorities	The technological priorities regard: • Energy storage; • Renewable technologies; • Smart grids; • Electric mobility; • Smart cities; • Smart home; • Smart industry; • Predictive maintenance; • Digitalization; • Autonomous world; • Safety; • Financial services.
Relation to SDGs	Enel's aims and scope are related to the following SDGs: • SDG 13: Climate action; • SDG 7: Affordable and clean energy; • SDG 9: Industry, innovation, and infrastructure; • SDG 11: Sustainable cities and communities.

Source: Authors' elaboration from openinnovability.enel.com

Following the analysis, a set of 4 key drivers related to the SOI was identified to represent initiatives of OI towards sustainability. These drivers – Digital platform for crowdsourcing (through owned content and content from third parties), Physical Hubs & Labs, Projects in line with the SDGs, and Dissemination (enabling technologies) - were compiled based on the website's information. The identified drivers, as shown in Table 2, bring out the importance of innovation ecosystem concept as a catalyst for sustainability (Granstrand and Holgersson, 2020).

Table 2 depicts the key drivers emerged, descriptions, and examples of related initiatives.

The first driver is related to the huge potentiality of the digital platform for crowdsourcing, in terms of predisposition (and the possibility of a proposal) of innovative sustainability-oriented challenges. Indeed, Enel, through such initiatives based on great flexibility and ability to adapt to different development timelines for various technologies, has taken part in more than 500 collaborations over the past 6 years. These collaborations are characterized by timelines and investments according to the specific time and resources needed depending on the technology and the needs of the start-up. Furthermore, Open Innovability ®

is able to attract people around the world to come together and share innovative ideas about how the solution of complex problems related to the energy sector. Crowdsourcing platform Open Innovability® has been able to reach a community of 500 thousand "active solvers" from more than 100 countries, who have proposed more than 7 thousand solutions.

On the other side, Open Innovability ® has developed innovative hubs and labs to bring together researchers, creators, and innovators to nurture ideas into industry-changing products and services as well as create a direct contact with specific geographic areas.

Open Innovability ® is committed to several projects related to the SDGs, focusing not only to the environmental sustainability challenges – through the research regarding innovative technologies – but also by addressing social sustainability questions through entrepreneurial and building cognitive/relational intercultural capabilities courses.

Finally, in order to thrive the sustainable innovation, Open Innovability ® is actively committed to the dissemination of success stories with the aim to enhance the visibility, comprehension, and implementation of SOI initiatives, highlighting the importance of the use of key digital technologies, such as Artificial Intelligence (AI), Internet of Things (IoT), and robotics, in a sustainability management context (Schöggl et al., 2023).

Table 2 – Enel's key drivers related to the SOI

SOI's Key drivers	**Description**	**Examples**
Digital platform for crowdsourcing	***1)Owned content (Inducement prize contests)*** Open Innovability ® is committed to the launch of sustainability challenges in order to find innovative solutions worldwide by setting a reward in euros or funding activities. ***2) Content from third parties*** Open Innovability ® leverages a digital platform for crowdsourcing where small businesses and entrepreneurs can request a collective creation process to solve their	• *The PITCHH challenges – Open Innovation opportunities*: promotes collaboration between big corporations, SMEs and startups, technology centers, and other for increasing the competitiveness of European industry (reward: up to 10,000 euros) • *Sustainable Synergies*: *Interconnected Systems for Positive Impact* aims to promote the operational and commercial roll-out of services addressing interconnected systems for positive impact (funding up to 200,000 euros) • Openinnovability.enel.com: platform open to third parties to propose

	complex problems.	their challenges
Physical Hubs & Labs	Open Innovability ® develops innovative hubs and labs intended as physical space that brings together researchers, creators, and innovators to nurture ideas into industry-changing products and services. The new technological solutions and business models are scaled up internationally, making full use of Enel's global network.	• Bari (Italy): Lab focused on low voltage smart grid and sensors • Barcelona (Spain): Living Lab focused on the network digital twin technologies and HV/MV grid technologies
Projects in line with the SDGs	Open Innovability ® is committed to several projects within the scopes of Sustainable Development Goals, such as: • Net-Zero ambition • Electrification • People • Environment • Growth accelerators • Pillars	• Futur-E Teruel: seeks to breathe new life into thermal power plants • "Programa de recambio": aims to replace wood-burning stoves with electric air-conditioning systems • WIRED Connecting intercultural skills: an awareness building course on cognitive/relational dynamics from intercultural perspective • Supplier program: aims to support the growth path of companies
Dissemination (enabling technologies)	Open Innovability ® is committed to the dissemination of success stories that demonstrate how an action, intervention, or process triggered innovation in reference to sustainable development.	• Enel and Myst AI – Optimizing energy forecast. • Enel and Alesea: IoT technology for supply chain optimization • Aerones & Enel Green Power advance wind energy thanks to robotics

Source: Authors' elaboration from the openinnovability.enel.com

5 Final implications and conclusion

The findings highlighted the potential related to the concept of "Open Innovability", consisting of crowdsourcing the best talent, ideas, and technologies to scale them up into disruptive as well sustainable business models. In order to reach this goal, the ecosystem is crucial to, from one hand, attract new ideas and talent with different skills or thoughts from all over the world, and, from another hand, offer access to a global network and resources in order to thrive the sustainable innovation progress and improve the portfolio of products and services. The open collaboration with start-ups, SMEs, large companies,

academics, internal and external experts, and investors, makes possible to identify the brightest innovative solutions and drive sustainable development. This is in line with the literature which has previously emphasised that SOI practices require openness (van Oostrom and Fernandez-Esquinas, 2017), positive attitudes towards knowledge sharing and sourcing (von Briel and Recker, 2017), and creativity (De Brentani, 2001).

OI and sustainability intertwine, fostering and being in turn fuelled by a network of multi-layer relationships through which relevant knowledge and creativity flow through a framework of sustained shared value (Du et al, 2014), thus allowing to achieve long-term competitive advantage (Costa and Matias, 2020; Zhang et al., 2023).

In particular, SOI is related to the use of digital platforms as an effective way to "outsource work to the crowd" (Howe, 2006), in order to crowdsource thoughts, ideas and solutions of innovative sustainability-oriented challenges, which should be characterized by great flexibility in terms of funding policies and timeline according to the specific technology and needs of innovators. In addition, the results highlight that the adequate combination of physical and digital environments can attract people from all around the world as well as create connections in the territory with the aim to share innovative ideas and find different solutions related to several sectors. Moreover, SOI includes several projects related to the SDGs, showing organizational commitment to sustainable progress, and emphasizes the key role of major enabling technologies of digital transformation in successful SOI initiatives, pointing to relevant synergies and spillover effects (Schöggl et al., 2023).

The implications of the paper are both theoretical and practical.

From a theoretical point of view, the study contributes to the existing literature on SOI, particularly in the sector of energy, identifying key drivers - Digital platform for crowdsourcing (through owned content and content from third parties), Physical Hubs & Labs, Projects in line with the SDGs, and Dissemination (enabling technologies) - which allow representing OI initiatives towards sustainability.

Furthermore, this analysis may provide practitioners and policymakers with how OI could support organizations in creating and conveying sustainability objectives. Specifically, it is expected that the SOI practices need to be nurtured by policies in order to enhance OI-based ecosystems (Granstrand and Holgersson, 2020).

With reference to managerial implications, the evidence provided by this case study allows us the emerging considerations of an analysis perspective that looks at organizational "openness" as a critical success factor for both innovation and sustainability solutions. Indeed, the implementation of SOI practices is based on the activation and involvement of the relational component in the innovation process.

Specifically, the three main macro-activities of the innovation process -input, throughput, and output (Vermeulen et al., 2003) – should be connected to each other by moments of feedback and cooperation, coming from third parties, who with their contribution offer important suggestions not only to define increasingly successful products and services, but new inputs to trigger the SOI practices, thus representing an important channel for obtaining facilitated access to resources, such as information, technologies, and new knowledge (Du et al, 2014).

Finally, it is possible to highlight the main limitation of the paper, in particular, related to the methodological approach adopted. In fact, the focus on website content analysis of a single case study certainly provided a holistic account but of a specific, unique, and bounded system (Denzin and Lincoln, 2008).

Therefore, future research intends to include several cases to further investigate organizations' SOI practices (Stake, 2013). The contents analysed could thus be more reliable, giving greater rigor to the study of the observed phenomenon (Gustafsson, 2017).

Furthermore, it could be considered to conduct in-depth interviews to explore the point of view of the organization's managers and representatives, in order to provide much more detailed information on the topic (Boyce and Neale, 2006).

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Knowledge Worker Resilience and Creativity

Anna-Maija Nisula*

LUT Business School
LUT University, Lahti
Finland

Ilona Toth

LUT Business School
LUT University
Lappeenranta; Finland

Heidi Olander

LUT Business School
LUT University
Lahti, Finland

* *Corresponding author*

Abstract

Knowledge workers are central actors for organizational performance and also widely in societies. Specifically, they are central sources, producers and orchestrators of knowledge, in which work creativity plays an important role. The goal of this paper is to shed light on determinants of knowledge worker creativity. We investigate resilience and self-efficacy as predictors of knowledge worker creativity by suggesting that effect of resilience is both direct and indirect, that is self-efficacy works as a partial mediator between knowledge worker resilience and creativity. We collected data from 419 knowledge workers in Finland to test the research model. The model was tested using partial least squares structural equation modelling (PLS-SEM). The findings supported our hypotheses. This study contributes to research on knowledge worker creativity and individual resilience in organizations.

Keywords – Resilience, Self-efficacy, Creativity, Knowledge worker

Paper type – Academic Research Paper

1 Introduction

Knowledge workers (KWs) are central actors for organizational performance and wider (Edgar et al., 2015; Seth & Lee, 2017). In organizations, the KWs are both processors of knowledge and organizers of their work, as they perform autonomous, complex and knowledge-based tasks (Davenport et al., 2002; Jacobs, 2017; Kelloway & Barling, 2000), such as constant problem solving and knowledge creation. In addition, knowledge work as a profession (Kelloway and Barling, 2000) can be seen as a creative work, as knowledge workers use their knowledge and competences to construct their work in unique (creative) ways (Anand et al., 2002; Södergren, 2002), that is, knowledge work is based on KW's personal dispositions and knowledge.

While much of research have investigated employee creativity (e.g., Tierney and Farmer, 2002; Amabile, 1983; Liu et al., 2016) in organizations, KW creativity has received less attention. The theory of individual creativity (Amabile, 1983; Csikszentmihalyi, 1996; Liu et al., 2016) and social cognitive theory (SCT) (Bandura, 1989) suggest that an individual's behaviour is influenced by intra-individual psychological factors as well as contextual factors. Of the individual factors, motivations (Liu et al., 2016) and creative self-efficacy (Tierney et al., 2002) are most studied determinants of creativity. However, in knowledge work, the motivational aspects, such as high autonomy, need for self-realization and competence, are essentially inherent in the characteristic of knowledge work, and therefore there is need to shed light on other than motivational factors of KW creativity. In this regard, individual's personal resources (excluding creative self-efficacy, which is studied as a motivational factor (Liu et al. 2016) have received less scholarly attention, although their role is central for creativity in a work that essentially involves high degree of autonomy (enabling determinant of creativity).

In this study we investigate resilience and general self-efficacy (GSE) as determinants of KW creativity. In contexts other than knowledge work, we find that resilient individuals are open to novelty, able to improvise in situations of uncertainty and change (e.g., Youssef & Luthans, 2007), and they are also able to turn negative emotional experiences into positive ones (Youssef & Luthans, 2007; Fredrickson, 2011). As creativity, that is, ability to generate novel ideas requires to accept the ambiguities and uncertainties of such a creative process (Czikszentmihalyi, 1996), the concept of resilience is an appropriate research target to shed light on intra-individual antecedents of creativity. In addition,

resilience is one component of the concept of personal resources (Luthans et al., 2007) and psychological capital (Luthans & Youssef, 2007). It is found to contribute to individuals' work engagement (Hodges, 2010), work performance (Luthans et al., 2007; Luthans et al., 2005), organizational effectiveness (Bustinza et al., 2019), well-being at work (Luthans & Youssef, 2007), satisfaction in work (Badran & Youssef-Morgan, 2015), career (Lyons et al., 2015), and openness to change (Malik & Garg, 2017; Wanberg & Banas, 2000). As a personal resource, resilience refers to an individual's capacity to master their personal growth (Bakker & Demerouti, 2014; Xanthopoulou et al., 2009) and to adapt to or master their environment (Hobfoll et al., 2003), a capacity that is crucial in complex and challenging knowledge work (Sonnenfeld, 2002). We therefore ask: *What is the relationship between knowledge worker creativity and resilience*?

To address the above research gaps, we conducted a quantitative study with the data collected from organizational knowledge workers (N=419) by using partial least squares analysis (SEM PLS; Ringle et al., 2015) and related procedures.

2 Theoretical frameworks

We build on research on individual creativity (Amabile, 1983, Liu et al., 2016, Shalley, Gilson and Blum, 2009), personal resources (Luthans et al., 2007) and psychological capital (Luthans, 2002; Luthans & Youssef, 2004).

Knowledge worker Creativity

Creativity is an individual's ability to generate novel ideas (Amabile, 1983) and to pursue novelty in a variety of situations, problems, and contexts (Csikszentmihalyi, 1992, 1996; Tierney, et al., 1999). In motivation theories, creativity reflects an individual's highest psychological needs, self-realisation, and personal fulfilment (Deci and Ryan, 1985; Maslow, 1987).Scholars acknowledge that creativity is central in knowledge work (Alvesson, 2004; Starbuck, 1992) and knowledge-intensive careers (Anand et al., 2002; Sodergren, 2002). In fact, knowledge work can be seen as creative work in the sense that it consists of constant problem solving, orchestration of knowledge, and knowledge creation, that is, producing novelty for performance (Davenport et al., 2002; Dul et al., 2011). Further, knowledge work as a profession (Kelloway & Barling, 2000) or career requires creativity, as it is based on individual's knowledge and is constructed in original (creative) ways (Anand et al., 2002; Södergren, 2002), that

is, it is based on individuals' personal dispositions, knowledge and life aspirations. For knowledge workers, creativity is an important source of personal satisfaction as it constitutes the satisfaction of self-realisation and meaningfulness of work (Martela & Pessi, 2019).

Knowledge worker resilience

Scholars have investigated individual resilience as adaptive coping (Sinclair and Wallston, 2004), personal resource (Luthans et al., 2007) and psychological capital (Luthans, 2002; Luthans & Youssef, 2004). Sinclair and Wallston (2004) suggest that resilient coping behaviour refers to an individual's ability to employ their cognitive skills in a flexible and effective ways for active problem solving despite adverse circumstances. The resilient coping involves reliance on one's dispositional resources and it is likely to foster positive adaptation in the face of adversity. Further, Sinclair and Wallston, (2004) claim that individual's coping experiences develop their dispositional traits, such as self-efficacy, and thereby an individual's willingness to engage actively to various adverse situations, such as complex problem solving, increases (Kumpfer, 1999). Thus, individuals with resilient coping are willing to engage in creative and adaptive problem solving and wide variety of adverse situations (Sinclair and Wallston, 2004).

General self-efficacy

In contrast to the domain specific creative self-efficacy (Tierney and Farmer, 2002), general self-efficacy (GSE) refers to an individual's confidence to perform successfully across a variety of different situations (Eden, 1988; Judge, Erez aet al, 1998; Chen, Gully and Eden, 2001). Thus, GSE is seen as a motivational trait (Chen et al., 2001), which develops over one's life span with accumulated experiences of success and failures across various task domains (Chen et. al., 2001). Thus, GSE can act as an effective shield against adverse events and circumstances (Chen et al., 2001, Eden, 1988). As a part of personal resources, GSE also corresponds with intrinsic motivation to pursue goals (Bakker & Demerouti, 2008).

To sum, knowledge workers' creativity refers to their discretionary behaviour, need for self-realisation, and desire to satisfy personal psychological needs and life aspirations. Knowledge worker resilience refers to their persistence to cope with adversity to satisfy these psychological needs and life aspirations as well as the adversity caused by creativity itself, whereas self-efficacy refers to their belief and competence to perform in a wide variety of circumstances.

Hypotheses development

Given the positive work-related outcomes to which resilience is found to contribute Hodges, 2010; Luthans et al., 2007; Luthans et al., 2005; Luthans & Youssef, 2007; Badran & Youssef-Morgan, 2015; Malik & Garg, 2017; Wanberg & Banas, 2000), we suggest that resilience contributes to knowledge workers' creativity. Sonnenfeld (2000) suggested that resilience is important in mastering adversities in creative careers. In addition, as a kind of cognitive flexibility and tolerance of paradoxes, resilience can be associated with creativity (Csikszentmihalyi, 1996; Meneely & Portillo, 2005). Specifically, pursuing novel ideas is challenging because it demands tolerance to accept uncertainty and ambiguity resulting from the generative dance between creating and constantly shaping ideas and situations, which call for high levels of resilience (Masten & Powell, 2003). Sinclair and Wallston (2004) also found that resilience is positively linked with coping behaviours in problem solving. Indeed, generation of novel ideas can be frustrating and cause feelings of inadequacy, especially, when ideas do not emerge and flow. Thus, knowledge workers with high levels of resilience are likely to demonstrate higher levels of creativity, because they accept and are able live under circumstances of uncertainty and ambiguity. We therefore posit the following hypothesis:

H1: Knowledge workers' resilience is positively related to their creativity.

Resilience refers to individual's positive adaptation while facing and overcoming adversities (Luthar et al., 2000) and it is found to foster individuals' work performance (Luthans et al., 2005) and change orientation (Hobfoll, 1989; Wanberg & Banas, 2000).

In addition to specific adverse situations, resilience is associated with day-to-day adversities (e.g. Davydov et al., 2010). It is especially crucial in mastering the balance between one's creative dispositions and environment (Sonnenfeld, 2002). Wagnild (2009) found that highly resilient individuals use resilience as an adaptable mechanism to handle adversity and they thus recover more quickly from setbacks.

Sinclair and Wallston, (2004) suggest that individual's prior coping experiences enhance their dispositional traits of self-efficacy, which in turn increases their willingness to engage in various adverse and ambiguous situations. Thus, GSE develops over life span and along with experiences, in which an individual's resilience plays central role. Specifically, highly resilient individuals likely engage

in variety of situation and develop their self-efficacy through these experiences. We therefore posit the following hypothesis:

H2: Knowledge worker's resilience is positively related to their GSE

In creativity research creative self-efficacy, that is, individual's confidence to perform in situation that demand creativity is associated with individual creativity (Tierney et al., 2002). Similarly, we suggest that GSE, individual's confidence to perform successfully in variety of emerging situations, has an influence on knowledge worker creativity. Specifically, given that knowledge work is complex and constant orchestration of knowledge in various circumstances, we claim that GSE is important determinant for knowledge worker creativity. We therefore posit the following hypothesis:

H3: GSE is positively related to KW creativity

3 Methodology

3.1 Sample and measures

3.1.1 Sample

We obtained data from Finnish higher educated organizational knowledge workers, who are members of the trade union of the Academic Engineers and Architects in Finland (TEK), through a web-based questionnaire in March–May 2016. The respondents are university graduates, who work as experts or in leading positions in the field of technology and architecture. Thus, they are knowledge workers (e.g. Atkins, 1999; Rüdiger & McVerry, 2007). We distributed 4,940 questionnaires, receiving 423 responses (response rate of 8.6 %) resulting in the effective sample of 419 responses.

The descriptive statistics were as follows: Of the respondents (N=419), 27.0 per cent (N=113) were female while 73.0 per cent (N=306) were male. A total of 2.9 per cent (12) were students, 3.1 per cent (N=13) had a Bachelor's degree, 78.8 per cent had a Master's degree (N=330), and 15.3 per cent had a Doctorate (N=64). In terms of age, the share of the respondents was as follows: 13.4 per cent (N=56) were 29 or under; 20.3 per cent (N=85) were aged 30–39; 26.0 per cent (N=109) were aged 40–49; 21.5 per cent (N=90) were aged 50–59; and 18.9 per cent (N=79) were 60 years of age or older.

3.1.2 Measures

We used validated and reliable scales and multi-item measures for the constructs based on a seven-point Likert scale (*1 = strongly disagree*, *7 = strongly agree*). *Creativity* was measured using a six-item scale adapted from Tierney, Farmer, and Graen (1999). The respondents self-rated their creativity because, as knowledge workers, they are capable of evaluating their own creative behaviour (Conway & Lance, 2010; Shalley et al., 2009). For *resilience*, we used the validated and reliable Brief Resilient Coping Scale (BRCS) (Sinclair & Wallston, 2004). *General self-efficacy* (GSE) was measured with the scale by Chen et al. (2001).

Finally, we controlled for gender as a dummy variable (0 = female, 1 = male) and education to rule out their influence on resilience, creativity, and GSE. We used five categories in assessing the respondents' ages (1 = 29 years or younger; 2 = 30–39 years of age; 3 = 40–49 years of age; 4 = 50–59 years of age; 5 = 60 years or older) and four categories in assessing their education level (1 = student, 2 = Bachelor's degree, 3 = Master's degree, 4 = Doctorate).

3.2 Measurement model

The PLS method was used for the analyses (PLS; version 3.2.7 of SmartPLS; see Ringle et al., 2015) and IBM SPSS Statistics 24 software for the analyses. To assess the model's predictive accuracy (R^2) and the significance of the structural paths, we employed the PLS bootstrapping procedure. We first assessed the internal consistency and discriminant validity of the scales, as described in the following.

3.2.1 Measurement model validation

For measurement validation, we assessed both internal consistency and discriminant validity, both of which indicated that the model had good validity and reliability for the operationalisation of the concepts under interest.

Regarding internal consistency, the construct reliability (CR) and convergent validity of all constructs demonstrated high internal consistency. All constructs (Table 2) had a CR value (0.807-0.908) above the 0.7 threshold determined by Bagozzi and Yi (1988), and all the average variance extracted (AVE) values (0.516-0.601) exceeded the 0.5 cut-off determined by Fornell and Larcker (1981). Likewise, the loadings of all the items were high enough and statistically significant, which means that they all related to their specific constructs.

Table 1: Construct statistics and correlations

Construct	Mean	SD	Creativity	Resilience	Self-efficacy
Creativity	5.0238	.9224	**0.776**		
Resilience	4.9600	.94922	0.478**	**0.718**	
Self-efficacy	5.8353	.69468	0.460**	0.437**	**0.766**

NOTE: **Correlation is significant at the 0.01 level (two-tailed)
The square roots of the AVEs are displayed in the diagonal

Discriminant validity indicates the extent to which any one construct differs from the others. While assessing discriminant validity, the square root of each construct's AVE value should be greater than the variance shared between constructs in the model (Fornell & Larcker, 1981). As shown in Table 1, all the measures demonstrated validity and reliability in operationalising the study variables. In addition, significant correlations were observed between the independent variable and the dependent variable, suggesting a link between the constructs.

Overall, the above-mentioned tests showed that the model had good validity and reliability for the constructs of interest

3.3 Results

As expected, the findings show support for our hypotheses (Figure 1): Hypothesis 1, the path from resilience to creativity was statistically significant (B=0.365, p < 0.000). Hypothesis 2, the path from resilience to GSE was statistically significant (B=0.472, p< 0.000). Hypothesis 3, the path from GSE to creativity was statistically significant (B=0.266, p < 0.000). The results shows that knowledge worker resilience is related to their creativity both directly and indirectly via GSE. Thus, GSE acts as a partial mediator in the relationship between knowledge worker resilience and creativity

The control variables of Age (B=0.253), Education (B=0.150) and Gender (B=0.159) were significant for creativity.

In addition, Age (B=0.126) was significant for resilience, whereas Education (B=0.164) was significant for GSE. The finding that education positively related to knowledge workers GSE implies that GSE develops along with one's life span through experiences (Shelton, 1990; Chen et al, 2001). The R^2 0.470 for creativity implies that the model could explain 47,0 per cent of the variance in knowledge worker creativity.

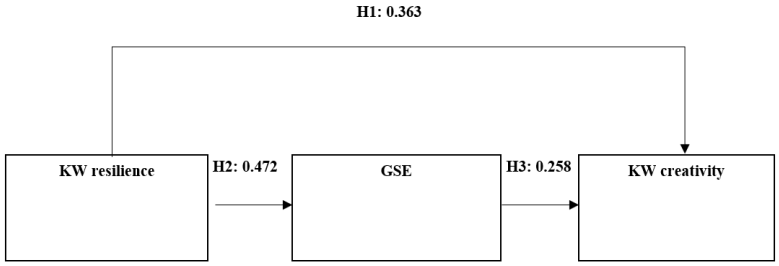

Figure 1: The research model and significant paths (control variables are omitted for clarity reasons)

4 Conclusions

Our findings show that both resilience and general self-efficacy are positively related to knowledge worker creativity. While prior research has investigated both resilience and creativity separately, there is less research that links these concepts in work contexts which require a continuous display of creativity, such as knowledge work. Thus, there is a clear need to investigate resilience in relation to knowledge worker creativity. We contribute to research on knowledge worker creativity (Dul et al., 2019) and individual creativity in organizations (Amabile, 1983). While earlier research investigated motivation mechanism of employee creativity (e.g., Liu et al., 2011; Amabile, 1983) in organizations, our study sheds light on employee creativity in knowledge work, that is in an occupation that inherently involves creativity (Starbuck, 1992) and in which individuals need for autonomy and self-realization as well as motivation for creativity are high. In terms of organizational resilience, our research on the relationship between individual's resilience and knowledge worker creativity can also contribute to research on organizational resilience, which is understood as a multi-level phenomenon (Borg et al., 2022; Hartmann et al., 2019).

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Digital Technologies for Supporting Firms' Absorptive Capacity: A Systematic Review

Salvatore Tallarico*

Department of Economics and Management
University of Pisa
via Cosimo Ridolfi 13, 56124, Pisa, Italy

Valentina Lazzarotti

LIUC Università Cattaneo
School of Industrial Engineering
Corso Matteotti 22, 21053 Castellanza, Italy

Simone Lazzini

Dept. of Economics and Management
University of Pisa
Via Cosimo Ridolfi, 10, 56124, Pisa, Italy

Luisa Pellegrini

Dept. of Energy, Systems, Territory and Constructions Engineering
University of Pisa
Largo Lucio Lazzarino, 56126, Pisa, Italy

** Corresponding author*

Abstract

A firm can improve its innovation processes by accessing useful external knowledge, profiting from the Open Innovation outside-in process.
However, to benefit from the flow of knowledge from the firm's outside boundary, the firm's Absorptive Capacity - the ability to correctly acquire, assimilate, transform, and exploit external knowledge according to the innovation needs – plays a pivotal role. So, firms must equip themselves with relevant tools to support all Absorptive Capacity activities.
Despite digital technologies seem to be very promising tools, currently, their supportive role in firms' Absorptive Capacity activities is understudied, hence generating a literature gap related to a very rising topic.

This work aims to contribute to filling this gap by proposing a structured literature review of academic research papers from the Scopus database.
The main results of this research are three: i. the recognition of the most studied digital tools in supporting Absorptive Capacity activities; ii. the explanation of how the identified digital tools support Absorptive Capacity activities; iii. the impact of using digital tools for supporting Absorptive Capacity activities on firm performance.
Contributions are both theoretical and practical.
Theoretically, this work is a first step in linking Open Innovation, Absorptive Capacity, and Information and Communication Technologies theories, often studied separately. In addition, the proposed literature review highlights new possible topics to be researched to improve the scientific knowledge about the phenomenon under investigation.
Practically, the results of this work lead firms' innovation managers to select the most appropriate digital tools to support Absorptive Capacity activities to enhance firms' performance.

Keywords – Open Innovation, ICT, Dynamic Capabilities

Paper type – Academic Research Paper

1 Introduction

According to the Open Innovation (OI) outside-in process, a firm that cannot improve its innovation processes by using only its internal abilities can look outside the firm boundaries to access useful external knowledge (Mina et al., 2014).

However, more is needed for a firm to take advantage of a growing level of openness. Indeed, to benefit from the external flow of knowledge, firms have to rightly acquire, assimilate, transform, and exploit the external knowledge according to the innovation needs (Lazzarotti et al., 2015). In other words, firms must have an adequate level of Absorptive Capacity (ACAP) that consists of the ability to 1) find, evaluate, acquire, and collect valuable knowledge from external sources for their business (Acquisition Capacity) (Bae et al., 2020); 2) absorb, analyse, and interpret the acquired knowledge according to their innovation processes (Assimilation Capacity) (Fosfuri and Tribo, 2008); 3) modifying their internal routines to ease the assimilated knowledge use (Transformation Capacity) (Camisón and Forés, 2010); and 4) using the transformed knowledge for improving their existing products and services and creating new ones (Exploitation Capacity) (Jiménez-Barrionuevo et al., 2011). Acquisition and

Assimilation Capacities build the firm's Potential ACAP, while Transformation and Exploitation Capacities build the firm's Realised ACAP (Zahra and George, 2002).

Realised ACAP follows Potential ACAP; thus, to obtain an overall high level of ACAP, firms must achieve the objectives of each ACAP dimensions (Vega-Jurado et al., 2008), equipping themselves with the most appropriate tools for their execution.

Digital technologies and specifically those Information and Communications Technology (ICT) tools which are part of the digital infrastructure (Nambisan, 2017) – such as intranet and extranet, audio-video technologies, social media, crowdsourcing platforms, artificial intelligence, blockchain and all others that allow users to create, store and exchange information – can support firms in improving their ACAP level.

The link between digital tools and ACAP is a rising topic in the current literature. However, most contributions focus on the relationship between firms' technological investments and ACAP or a (generic) ICT adoption and ACAP.

For instance, Dong and Yang (2015) consider the firms' ICT investments as an internal moderator of the ACAP, while, more recently, Cuevas-Vargas et al. (2022) highlight the positive effect of ICT adoption on firm ACAP level, and Molina-Morales et al. (2018) investigate the impact of the rate of adoption of disruptive technologies on Potential and Realised ACAP.

Although the debate about the potential use of digital tools is ongoing and lively for the firms' need to manage ever-larger amounts of data and acquire and use them quickly, there is a gap related to identifying how single technologies support the ACAP processes within firms.

This work aims to fill this gap, by answering the following research questions:

RQ1. What are the most studied digital technologies for supporting firms' ACAP activities?

RQ2. How do they support the specific dimensions of ACAP?

RQ3. What is the impact of digital technologies for supporting ACAP on the firm's performance?

Specifically, to deal with the above questions, we consider five technologies clusters: Idea, Innovation and Knowledge Management Tools; Collaboration platforms; Data analytic and visualisation tools; Social Media and Online Community; and Enabling technologies.

The paper is organised into five sections. After the introduction, in the second section, the methodology is illustrated. The third section is dedicated to the paper selection phase, while the fourth section consists of the descriptive and content analysis phase. The conclusions and implications of the work are illustrated in the last section.

2 Research methodology

This paper proposes a systematic review of the articles about the most studied digital technologies for supporting firms' ACAP activities, overviewing primary studies and using explicit and reproducible methods (Greenhalgh, 1997).

According to Cerchione and Esposito (2016), we organised the systematic literature review in two main phases:

1. Papers selection
2. Descriptive and content analysis of the selected papers.

Phase 1 is divided into two steps: the material comprehensive search and the selection of papers to be analysed in detail. The first step includes identifying keywords, carrying out the search query, choosing the database source of the documents, and reviewing the selected database using the search query. The second step includes formulating the inclusion/exclusion criteria for selecting the papers.

Phase 2 is divided into two steps: the descriptive analysis and the content analysis. The descriptive analysis aims to aggregate the papers according to different perspectives to give an overall overview of the selected documents. At the same time, the content analysis aims to highlight the literature state-of-the-art about a specific topic.

3 Phase of papers selection

3.1 Material comprehensive search

The chosen source to select papers for the literature review was Scopus, an Elsevier's abstract and citation database working since 2004, ensuring a high level of rigorousness.

The set of the selected keywords, linked by the boolean logic functions to construct the search query, was: ("Information and Communication Technolog*"

OR "ICT" OR "digital tool*") OR ("Social network site*" OR "Social media") OR ("Opensource software*" OR "Open Innovation Platform*") OR ("Crowdsourcing platform*") OR ("Call4ideas platform*") OR ("Artificial Intelligence"), ("Online Communit*") OR ("Intranet") OR ("Data mining technique*") OR ("Discussion forum*") OR ("Shared database*") OR ("Document repositor*") OR ("Workflow's software*") AND ("Absorptive Capacity" OR "ACAP" OR "external knowledge acquisition" OR "external knowledge assimilation" OR "external knowledge transformation" OR "external knowledge exploitation").

The subject areas considered for the search were "Business, Management and Accounting", "Social Sciences", "Computer Science", "Economics, Econometrics and Finance", "Engineering", and "Decision Sciences", - while - the temporal window was from 1997 until 2023.

Finally, we considered only articles from English-language journals.

The initial hits found in Scopus were 105.

3.2 Selection of papers

We used two criteria for including/excluding the research documents. The first criterion is the selection of papers whose abstracts talk about digital technologies used for supporting ACAP activities. So, the abstracts of all 105 articles were read by the principal researcher and, in some cases of uncertainty, also by the other researchers. The second criterion concerns the papers' main body. In this case, the researchers fully read the articles to identify sections about digital technologies supporting ACAP activities.

Applying these criteria, the papers selected for the phase of descriptive analysis were 56.

4 Phase of descriptive and content analysis

4.1 Descriptive analysis

In this section, we presented a summary overview of the 56 selected documents according to the following six perspectives:

4.1.1 Papers over time

Figure 1 shows the distribution over time of the papers; most of the articles belong to the more recent years. In particular, 2022 is the year with more contributions (16 articles), followed by 2021 (7 articles) and 2020 (6 articles). Only a few articles belong to less recent years. This perspective highlights that papers that link digital technologies and ACAP are growing currently.

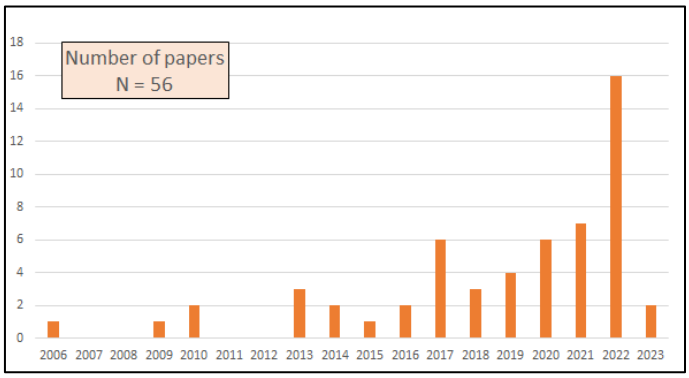

Figure 1 – Papers distribution over time

4.1.2 Papers by Countries

This perspective summarises the articles by the Country where they are developed. The two countries with more contributions are the United States and China – 13 and 10 papers, respectively. Australia contributes with 7 articles, India with 5, and European Countries (e.g., United Kingdom, Italy, France) have more than 20 (figure 2). So, the topic of this literature review is more studied in Countries with solid industrialised activity.

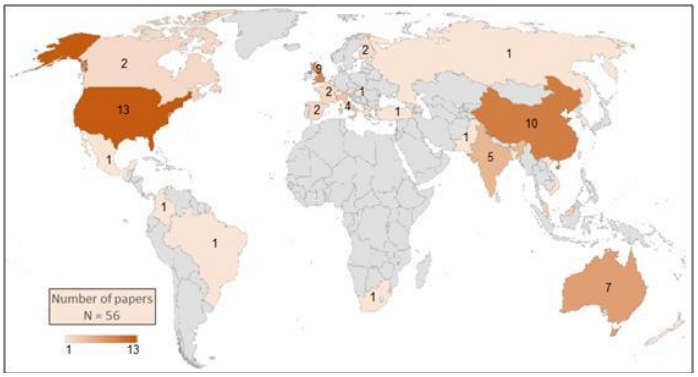

Figure 2 – Papers distribution by Countries

4.1.3 Papers by subject area

According to the chosen subject area (table 1), the selected articles are distributed as shown in figure 3. The most contributions (36) belong to Business, Management and Accounting Area, followed by Computer Science area contributions (21). The selected articles covered both technical and social areas. Indeed, this review matters range from the ICT field to organisational dynamics capabilities (ACAP).

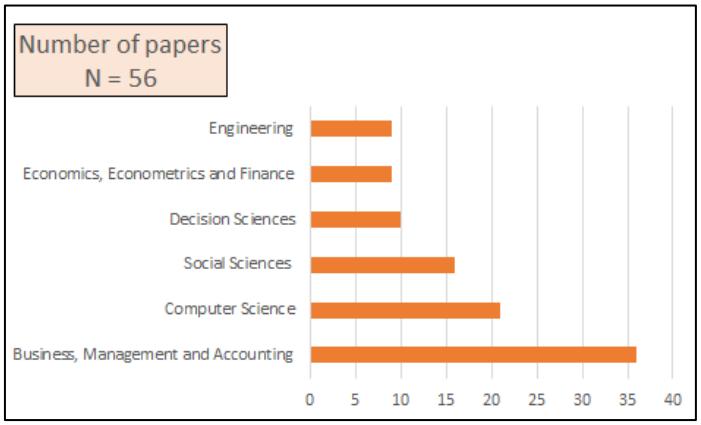

Figure 3 – Papers by subject area

4.1.4 Papers by methodology

This perspective analyses the distribution of the paper according to the methodology used (Figure 4). Most of the contributions are quantitative studies (38, of which 28 are surveys), followed by qualitative research 7 (3 single case studies and 4 multiple case studies), while hybrid works – quantitative and qualitative – are 4. Finally, 7 articles are theoretical research. The low occurrence of case study analysis highlights a substantial literature gap related to the qualitative aspects of ACAP improvement using digital tools in firms' context.

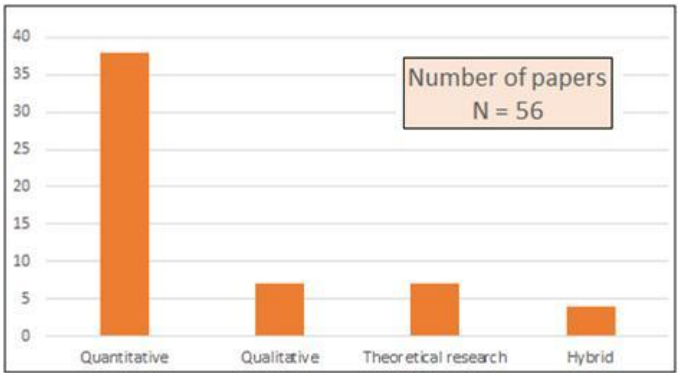

Figure 4 – Papers by methodology

4.1.5 Papers by digital technologies (clusters)

As mentioned in the introduction, we divided digital technologies supporting firms' ACAP activities into 5 clusters. This perspective frames the contributions according to the technology's clusters (figure 5). Many articles present multiple technologies that belong to different clusters.

The cluster "Social-media and Online Communities" is the largest one, gathering 35 papers, followed by the cluster "Data Analytic and Visualization Tools" with 27 papers, while 21 articles belong to the "Idea, Innovation, and Knowledge Management Tools" cluster. The latest clusters are "Enabling technologies" and "Collaboration platforms", with 9 and 8 contributions, respectively. A deeper analysis of how the clusters support firms' ACAP activities is part of the later content analysis.

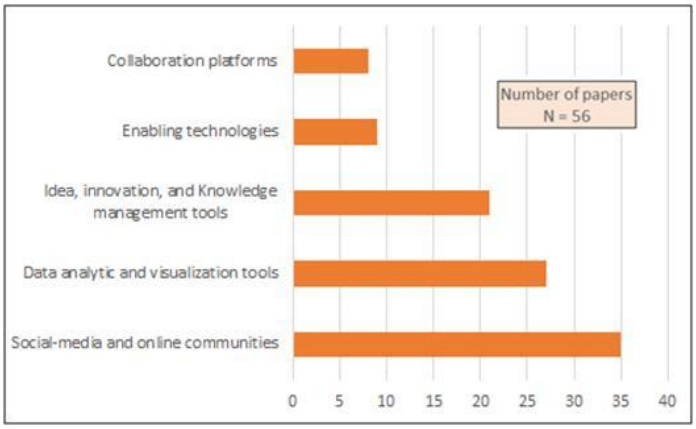

Figure 5 – Papers by digital technologies (clusters)

4.1.6 Papers by ACAP dimensions

The last perspective of the descriptive analysis is related to the number of articles by ACAP dimensions (figure 6). The Acquisition Capacity is the most studied, with, 49 articles. The Assimilation Capacity collects 30 contributions, Transformation Capacity 18, and Exploitation Capacity 21. So, currently, the literature is more focused on Potential ACAP, generating a knowledge gap about digital tools needed to support Realised ACAP activities within firms.

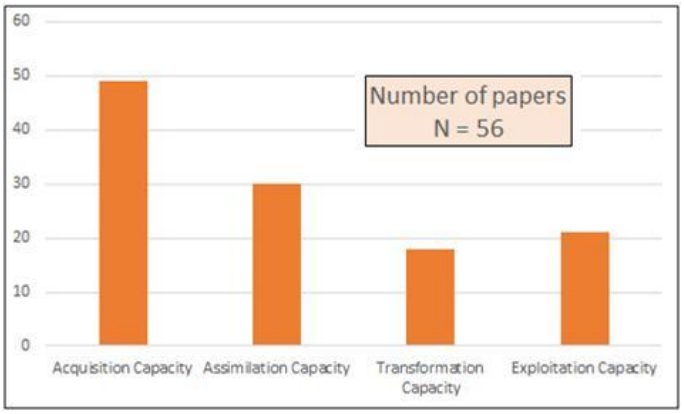

Figure 6 – Papers by ACAP dimensions

4.2 Content analysis and results

This section aims to give a detailed analysis of the 56 papers, analysing some issues covered by the literature about the relationship between ACAP and ICT in the firms' context. The identified content-perspective is that of the topic area: digital tools used to support firms' ACAP activities and their impact on firms' performance.

According to the topic area, five areas were identified.

4.2.1 Idea, Innovation and Knowledge Management Tools and ACAP dimensions

This area concerns the digital tools belonging to the Idea, Innovation and Knowledge Management Software (Technologies cluster 1) and ACAP dimensions.

The Idea, Innovation and Knowledge Management Tools allow for collecting, organising and prioritising idea from internal and external sources (Igartua et al., 2010), capturing, sharing and leveraging knowledge and expertise across the organisations (Wu and Hu, 2018; Moos et al., 2013), connecting potential partners

and collaborators fostering the innovation process. Examples of technologies in this area include Traditional ICT (e.g., the standard office applications), Intranet, Crowdsourcing platforms, Customer Relationship Management technologies, Enterprise Resource Planning Systems, and Blockchain Technology.

In Cluster 1 studied technologies are predominantly concerning the Acquisition and Assimilation dimensions of ACAP. For instance, Daniel and Huang (2019) and Marsh et al. (2017) discuss traditional ICT to support Acquisition and Assimilation capacity, *facilitating the external knowledge flow from firms' suppliers … and clients within the firms' boundary*.

According to Cassol et al. (2021), Verbeke et al. (2013), and Gururajan and Fink (2010), the Intranet, as *a network between individuals and groups for transmitting and storing* (external) *knowledge*, is used to support firms' Acquisition and Assimilation capabilities activities. Vukatana et al. (2022) recently highlighted using the Intranet to channel knowledge flow and support ACAP.

Liu et al. (2017) introduce the role of Crowdsourcing Platforms in knowledge acquisition activities, and Blohm et al. (2013) claim that this kind of technology, *tapping into the collective intelligence of the broad-based community of Internet users*, can help firms in improving all the ACAP dimensions.

In Nguyen et al. (2022), Customer Relationship Management technologies have a role in supporting Acquisition capacity, *increasing the efficiency of knowledge acquisition by providing firm-specific guidelines and easing transfers*. Araujo (2006) gives importance to Group Agenda Enforcement and Software that helps groups establish norms, routines, and procedures on how to use the technology features in supporting Acquisition and Assimilation capabilities, *guiding and coordinating groups' activities in interaction with each other … aggregating, evaluating, sharing, or structuring information*.

Instead, the link between the technologies belonging to cluster 1 and Transformation and Exploitation dimensions is often marginally studied. For instance, Cao et al. (2020) talk about the Transactive Memory System (tools that allow group members to share responsibility for encoding, storing, and retrieving information from different knowledge fields) as a tool to support ACAP dimensions *locating and integrating knowledge*, while Wook Seo et al. (2013) highlight the very positive influence of the Ubiquitous Decision Support System (tools able to identify the geographic location of the decision makers for allowing them the access to mobile networks to acquire information and make transactions) on ACAP activities.

Baker and Yusof (2017) highlight the role of the Enterprise Resource Planning System (such as the collaborative workflow systems) in improving Transformation and Exploitation capabilities, *supporting cross-functional business processes and enforcing a high degree of task interdependence and generating information about the processes by which an organisation performs its work* using external knowledge also.

Lastly, in a more recent work, Rajaguru et al. (2023) introduce the supportive role of Blockchain Technology for ACAP activities related to supply chain information and data integration; indeed, according to Chatterjee et al. (2022), *with the help of advanced cryptography, blockchain functions as a distributed open-service database*.

The content analysis of this area shows that Potential ACAP is more studied than Realised ACAP as concerns technologies belonging to cluster 1; hence, it emerges a first research gap, i.e. the need to further investigate the supporting role of cluster 1 technologies to ACAP. Furthermore, most articles analysed in this area build on quantitative methodologies to investigate the hypothesized relationship between cluster 1 technologies and ACAP dimensions. So, a second research gap appears: it is about "how" cluster 1 technologies support ACAP dimensions. To address this gap new qualitative studies on this topic are required.

4.2.2 Collaboration platforms and ACAP dimensions

The topic of this area is the relationship between Collaboration platforms (Technologies cluster 2) and ACAP dimensions.

According to Piller and West (2014), Collaboration platforms allow teams to share information and collaborate on projects in real time. Open Innovation platforms, Computer-assisted networks, Electronic Message Recording, and Crowdsource Platforms are examples of technologies that belong to this cluster.

Most of the contributions analysed to carry out information about this area concern the Acquisition and Assimilation dimensions of ACAP. In their quantitative work, Wang and Qi (2022) discuss the role of Open Innovation and Collaborative Platforms in supporting firms' Acquisition and Assimilation capabilities, *advantaging the firms' network connections linking the internal knowledge level and the external network location, and breaking down the barriers between users' internal knowledge and external interaction*.

However, albeit indirectly, Bag et al. (2023) also highlights the supportive role of that platforms for using external knowledge in supply chain activities, implying their support in firms' Transformation and Exploitation capabilities.

Huang et al. (2018) talk about Digital Platforms as technologies *that facilitate the creation, diffusion, and sharing of knowledge among communities*, improving the Acquisition capacity enabling *the rapid diffusion of best practices, strengthening customer relationships, gathering inputs and feedback for new product and service developments, reduce support costs, and incubate user-driven innovations*.

In the only one qualitative work of this area, Carayannis et al. (2006) claim that Computer Assisted Networks are *innovative networks able to interconnect various actors and create new opportunities for efficient interaction and cooperation regarding information dissemination and knowledge sharing, growing capacity to access knowledge* (Acquisition capacity) *through relationships*.

Arujo (2006) insert Electronic Message Recording among technologies allowing *members of global virtual teams to communicate across time and distance*, improving the Acquisition capacity.

Finally, the considerations related to how Crowdsourcing Platforms - also belonging to this technologies cluster – support the acquisition activities from external sources are the same shown in the previous area.

The concept analysis related to this technologies cluster supporting ACAP dimensions shows a profound lack in the literature about works related to how Collaborative platforms support Realised ACAP. In addition, the predominant quantitative view on this topic does not allow us to gain the qualitative aspects of the phenomenon.

4.2.3 Data analytic and visualization tools and ACAP dimensions

This area analyses how Data analytic and visualization tools (Technologies cluster 3) support ACAP dimensions.

Data analytics and visualization tools include all technologies allowing organizations to analyze and interpret extensive and different amounts of data and to identify trends and patterns (Arias-Perez et al., 2021; Lukic, 2014). This cluster is populated by technologies such as Big Data Analytic tools, Artificial Intelligence, Data Warehouses, On-line Analytical Processing and Data Mining, and Machine Learning tools.

In the papers belonging to this area, all ACAP dimensions are equally studied in relation to the support cluster 3 technologies give them, even if the quantitative methodology still prevails over the qualitative one.

The works of Bag et al. (2023) and Daniel and Huang (2019) introduce Big Data analytic tools as technologies supporting knowledge-based activities in terms of acquisition, assimilation, transformation and exploitation of new information. On the same view, Blohm et al. (2013) talk about the utility of that tools to correctly interpret *enormous volume and variety of big data acquired via Internet-based platforms* and how firms' *CIOs and other organizational leaders can develop an effective absorptive capacity to enable them to generate knowledge and value* from that data.

Artificial Intelligence (AI) is another technology investigated in relation to its support to ACAP; Bencsik (2021) links AI and Acquisition and Exploitation firms' capabilities. Specifically, in his work he highlights that the role of AI in knowledge acquisition activities is *to process enormous statistical data sets based on given parameters* while that in knowledge exploitation is *to provide the using of the acquired knowledge for machines for task completion, and to unleash knowledge so that it can get to humans, to the improvement of the decision-making process.*

Liu et al. (2020) add that AI can improve ACAP promoting *technological innovation through accelerating knowledge creation and technology spillover*. Specifically, they recognize the AI-based industrial robots' capabilities *to transform acquired information into knowledge and take justified subsequent actions* improving Transformation and Exploitation firms' capacity.

In their recent papers, Pessot et al. (2022), Schintler and McNeely (2022), and Li et al. (2022) also highlight the supportive role of AI for all ACAP dimensions by the automatic external knowledge extraction and using the acquired and transformed knowledge in the firms' industrial processes.

Chatterjee et al. (2022), in supporting Acquisition capacity, add to AI the Quantuum Computing technology. This modern cutting-edge technology *possesses algorithms that can accelerate the tasks done by machine learning* favoriting a quick and accurate acquisition of *particular data cannot be searched by ordinary technology*.

According to the literature, also others digital tools belonging to cluster 3 support firms' ACAP activities. For instance, Ahankoob et al. (2021) introduce the role of Building Information Modeling (BIM) tools in supporting ACAP activities. Specifically, they show that *the transparency function of BIM functional attributes is*

significantly correlated with Acquisition and Transformation dimensions of ACAP. Indeed, organizations are more likely to acquire and transform knowledge using a more transparent way of consistent, disclosure, and reliable information as BIM allows.

Adamides and Karacapilidis (2020) work is focused on different technologies supporting different ACAP dimensions. Argumentative knowledge construction support tools hold up knowledge-related Acquisition, Assimilation, and Exploitation activities, *offering alternative visualization schemas that help stakeholders control the impact of voluminous and complex data, while also accommodating the outcomes of external web services, thus augmenting individual and collective sense-makings*; Data Warehouses, On-line Analytical Processing, and Data Mining tools support Transformation and Exploitation dimensions *playing a prominent role in the development of current and future Decision Support Systems (..) integrating (aggregate) and managing (store/retrieve) in a single repository all the relevant data, metrics, and objectives*; Natural language processing text analysis tools, Machine Learning, and Computational Linguistics tools help in Acquisition and Assimilation activities *extracting relevant information from the huge amounts of human communication over the Internet or other (offline) sources*.

Finally, Arauju (2009) talks about Electronic Discussion tools, Devices to store a complete record of group interaction, and Analytical Tools to evaluate the information in a more objective fashion as technologies able *to support knowledge-related activities in globally distributed teams* quickly, helping in the knowledge acquisition and assimilation by firms.

Although this area has a good analysis level about all ACAP dimensions, there still is, as also shown for the previous areas, the need to deal with the topic through a more qualitative view.

4.2.4 Social Media and Online Community and ACAP dimensions

This area analyses the role of the Social-Media and Online Community (Technologies cluster 4) in supporting ACAP dimensions.

Social media, Discussion Forums, and Online Communities are the technologies that belong to this cluster, providing platforms for companies to engage with customers, partners and other stakeholders and gather insights and feedback (Scuotto et al., 2017).

The descriptive analysis has shown that cluster 4 is the most studied in the literature concerning ACAP activities.

In this area, the Acquisition and Assimilation dimensions of ACAP are the most studied. However, the many literature contributions concerning the relationship between social media and ACAP gives us some examples in which Transformation and Exploitation dimensions are also treated.

The recent works of Pham and Duong (2022), Xie et al. (2022), and Ho and Amin (2022) are just some examples of papers about the relationship between social media using and ACAP dimensions improving.

Cepeda-Carrion et al. (2022) demonstrate how family firms using social media to stay connected *with their customers and stakeholders are probably more oriented to develop open innovation practices and absorption capacity tasks*. Specifically, social-media-based interactions facilitate *knowledge transfer and in improving an organisation's absorptive capacity because social-media-based interactions structural linkage between a firm and its customers drives the capture, transfer, assimilation, and application of customer knowledge*. So, social media tools *impact each of the three abilities that make up a firm's absorptive capacity: the ability to identify the potential new product ideas* (Acquisition capacity), *assimilate new insights* (Assimilation capacity), *and apply new improvements to the existing offerings* (Exploitation capacity).

Peltola and Makinen (2014) discuss a positive relationship between using social media tools and acquiring and Assimilation capabilities.

Cao and Ali (2018) highlight the facilitator role of social media (such as blogs, wikis, and social networking sites) in *knowledge acquisition and application from diverse knowledge resources located within and outside the organisation that enhance ACAP in both aspects of identification and utilisation of knowledge*.

On the same view, Wieneke and Lehrer (2016) talk about social media (such as Facebook and Twitter) as the source from which organisations can acquire relevant data (Acquisition capacity), as the tool for the organisations' employees *to redefine the underlying questions and hypotheses for data analysis at frequent intervals based on their experiences* (Assimilation capacity) and to *scrutinise their processes and routines regularly in order to constantly develop new ideas for customer insight generation* (Transformation capacity) and *exploitation and adapt to changes in the environment* (Exploitation capacity).

In their extensive analysis, Schlagwein and Hu (2017) highlight that *using social media platforms effectively increases an organisation's ACAP*. Regarding the

Acquisition and Assimilation capabilities, *social media can support exploratory learning*, *which is how organisations acquire and understand external knowledge, allowing users to access data and information quickly*. Regarding the Transformation and Exploitation capabilities, *social media also enhance transformative learning interpreting knowledge and support the family firm's ability for exploitative learning, allowing new business applications or business processes to be created more effectively*.

Besides social media, Gururajan and Fink (2010) consider the role of discussion forums in external knowledge acquisition and assimilation by firms. In addition, Kumi and Sabherwal (2018) and Hung et al. (2018) agree to identify Online Communities as tools to support Acquisition capacity.

The output of this area analysis shows that the literature debate needs more research about social media supporting role in Realised ACAP activities and qualitative studies.

4.2.5 Enabling technologies and ACAP dimensions

This area concerns the relationship between Enabling Technologies (Technologies cluster 5) and ACAP dimensions.

All the tools needed to enable the technologies of the other clusters in supporting ACAP activities belong to this cluster. The Internet of Things (IoT), Cloud-based platforms, the Internet, and Extranet are examples of technologies of this cluster.

Because of the enabling role of these technologies in supporting tools belonging to all technology clusters, in this case, the selected articles concern all the ACAP dimensions equally.

Rajaguru et al. (2023) and Pessot et al. (2022) highlight the role of IoT as an enabler of technologies fitting to collect and monitor data from firm external sources (Acquisition capacity) and to connect all production machines and devices for using acquiring external knowledge (Exploitation capacity). Chatterjee et al. (2022) talk about IoT as a technology that helps the firm *to effectively recognize and assimilate any congenial external opportunity which is in consonance with absorptive capacity* (precisely, Acquisition and Assimilation capabilities).

Vukatana et al. (2022) describe Computer-based Systems as crucial enablers for technologies - such as data warehouses, search engines, data modelling and visualization, information management, and knowledge management tools – in

transferring and assimilating information making external knowledge explicit. In Pessot et al. (2022), Cloud-based Platforms ensure secure and protected data sharing, supporting technologies in knowledge acquiring and help in the integration of solutions in which *information is collected from customers through social media and in more accurate forecasts and better service levels thanks to analysis on data collected from websites, social media and platforms*. Ratten (2016) talk about Cloud Computing as *a service innovation in the ability of an organization to utilize and internalize knowledge management processes*, which is valuable for supporting knowledge Transformation and Exploitation activities.

Finally, in less recent works, some authors illustrate the role of the Internet and Extranet in knowledge Acquisition and Assimilation activities supporting remote communication and data sharing (Gururajan and Fink, 2010; Carayannis et al., 2006).

This area's concept analysis shows the need for more qualitative studies in which the enabling role of these technologies is duly treated.

4.2.6 Digital tools, ACAP and Performance

The last area of the Content analysis concerns the relationship between ACAP dimensions, supported by digital tools, and firms' performance improvement.

Only 14 of the 56 selected articles discuss the performance implications of the firms' ACAP activities using technologies, and all 14 papers discuss industrial performance.

Specifically, the most studied are the performance improvements due to using social media to support ACAP activities.

Cepeda-Carrion et al. (2022) and Scuotto et al. (2017) highlight how, using social media, family firms can improve non-financial performance, becoming more innovative and competitive. Ali et al. (2020) claim that *when social media is embraced by an organization for innovation, potential and realized absorptive capacity emerge, which leads to enhanced team innovation performance*.

Ammirato et al. (2019) link social media use for ACAP activities with increased knowledge worker productivity, while Cao et al. (2018) discuss the influence of social media on ACAP and the resulting increase in Team Creative Performance. Peltola and Makinen (2014) discuss how social media for ACAP activities enhances ideas development. Wang (2013) demonstrate that the more firms use social media to acquire and assimilate knowledge, the higher their learning performance is, while Ortega-Gutierrez (2022) highlight that social media use

allows firms to have access to customers and market information, fueling ACAP dimensions and then improving the collaboration with value partners and gathering new ideas allowing firms to be more service-dominant oriented.

According to Bencsik (2021), using AI for ACAP activities helps firms' creativity and productivity growth, and Liu et al. (2020) add that *AI affects technological innovation in four angles: knowledge creation, knowledge spillover, learning ability, and investment in R&D and talents.*

Lastly, Baker and Yusof (2017) and Cuevas-Vargas et al. (2022) discuss the relationship between the ICT tools used for ACAP activities and firms' learning performance.

The content analysis of this area highlights that studying the effects of ACAP activities supported by digital tools on performance is still to be deepened. Specifically, no work studies the effect of this relationship (ACAP dimensions and supportive technologies) on the firm eco-fin performance.

5 Conclusions and implications

This review aims to fill the literature gap related to the supportive role of digital technologies in firms' ACAP activities. Indeed, to our best knowledge, it is the first time that research has dealt with this information void.

Following the methodology shown in Cerchione and Esposito (2016), we propose a descriptive and content analysis of the papers selected from the Scopus database.

On the one hand, the descriptive analysis proposes a summary view of the articles and, in particular, highlights that the topic of this research has been investigated in High Industrialised Countries (USA, China, India, and the European Big Four Countries) through quantitative rather than qualitative studies in the Business, Management, and Accounting area predominantly, with a greater focus on Social Media and Online Community tools in supporting Potential rather than Realised ACAP activities.

Specifically, through the descriptive analysis, we can answer RQ1, proposing the papers by digital technologies (clusters) (figure 5) and identifying the most used technologies clusters for supporting firms' ACAP activities.

On the other hand, content analysis proposes a deep investigation of the papers' contents. It highlights how Idea, Innovation and Management tools (cluster 1), Collaborative Platform (cluster 2), Social Media and Online Community

(cluster 4) support Potential rather than Realised ACAP activities and how Data Analytics and Visualisation Tools (cluster 3) and Enabling technologies (cluster 4) equally support both Potential and Realised ACAP activities.

Specifically, through the content analysis, we can answer RQ2, illustrating how technologies belonging to the clusters support the specific dimensions of ACAP. Indeed, in section 4.2, we illustrated the information about the above relationship contained in the selected papers for each cluster.

However, the presence of primarily quantitative articles made the content analysis not simple; indeed, the use of quantitative methodologies, albeit finding a statistical relevance of the use of the technologies on the ACAP activities, provides explicit information about "how" questions rarely.

In addition, an area of content analysis is dedicated to the impact of the technologies used to support ACAP activities on the firm's performance; it highlights that only industrial performances are currently investigated (RQ3).

The contributions of this literature review are both theoretical and practical.

Theoretically, this study represents a crucial first step in the link among the literature of the Open Innovation, Absorptive Capacity, and ICT fields, analysing, for the first time, the current state of the art about the studied topic and highlighting gaps needed to be filled with new research. Indeed, future works should seize the qualitative aspects of the relationship between digital tools and the ACAP dimensions to explain better how technologies can support firms in ACAP activities. In contrast, quantitative studies about the supportive role of technologies on Realised ACAP activities and the impact of the relationship between technologies use and ACAP on firms' performance (both industrial and eco-fin) are required.

Practically, this research can be helpful to firms' innovation managers, or anyone involved in firms' innovation and R&D activities, to identify the most appropriate technologies to be adopted for improving their ACAP activities (both Potential and Realised) and then their performance (albeit limited to the industrial ones).

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How Can Consumers Behave Sustainably in the Fashion Industry? A Study of Determinants, Drivers, and Barriers for Different Sustainable Consumption Options

Valerio Schiaroli*

Sapienza University of Rome
Via Ariosto 25, 00185 – Rome (Italy)

Luca Fraccascia

Sapienza University of Rome
Via Ariosto 25, 00185 – Rome (Italy)
University of Twente
Drienerlolaan 5, 7522 NB – Enschede (The Netherlands)

Rosa Maria Dangelico

Politecnico di Bari
Via Edoardo Orabona, 4, 70126 - Bari (Italy)

** Corresponding author*

Abstract

A shift toward more sustainable production and consumption patterns is crucial. The fashion industry is responsible for negative environmental and social impacts along the value chain. Thereby, the fashion industry is one of the priority areas of intervention in the sustainability agenda.

Recently, the literature has devoted much space to the analysis of sustainable fashion consumption. Some literature reviews on sustainable fashion have been published recently. However, these focused on a specific consumption stage. Multiple alternatives to make, use, and dispose of fashion products sustainably are available among all consumption stages and an analysis of the determinants of consumer behavior for each option is missing so far. Such knowledge would be useful for a deeper understanding of sustainable consumption in the fashion industry, to define a holistic picture of the reasons that favor or discourage the adoption of sustainable behaviors for each phase of consumption.

This study aims to fill this gap by systematically reviewing the literature related to sustainable consumer behavior in the fashion industry. A product life cycle approach is adopted by analyzing consumers' perceptions and the influencing factors of consumer

behavior towards the sustainable options existing for each stage (i.e., production, use, and disposal). Specifically, these sustainable options can belong to the phase of garment choice (i.e., before consumer usage), the garment usage (i.e., during consumer usage), and when the consumer ceases to use the garment (i.e., after consumer usage). The research string used to collect articles was created by mixing keywords related to three main domains: consumer behavior, sustainability, and the fashion industry. The research string was launched on Scopus and Web of Science databases on 31st December 2022. After a series of screening following exclusion criteria, a final sample of 216 articles was included in the review.
Results show many factors driving or hindering sustainable consumer behavior. The main barriers to sustainable consumption are high price, skepticism, stereotypes, lack of knowledge, availability, and efforts to access product/service. Furthermore, consumers' environmental concerns and awareness seem to play a secondary role in the decision process. Conversely, high-quality, comfort, and style of garments, together with new emerging technologies and services, can positively contribute to sustainable consumption. Social media can help shift toward sustainable consumption practices, favoring the spread of sustainable knowledge and awareness among consumers. A future research agenda and several implications for managers are provided.

Keywords – Sustainable fashion, Consumer behavior, Product life cycle, Sustainable consumption, Systematic literature review.

Paper type – Academic Research Paper

1 Introduction

Clothes are able to satisfy several human needs such as warmth and protection, and to express one's own identity (Niinimäki, 2010; O'cass, 2000). The global fashion market is enormous and several companies operate in this industry to supply the human clothing demands. The fashion market is growing driven by mass production with a consequent increase in clothing use and disposal (McKinsey and Global Fashion Agenda, 2020). Further, unsustainable consumption patterns, such as fast fashion, are widespread (Dissanayake and Sinha, 2015). The clothing industry presents environmental impacts in each consumption stage (Pedersen and Andersen, 2015), accounts for 10% of global greenhouse gas emissions (European Commission, 2022), and is globally responsible for 40 million tonnes of textile waste a year (McKinsey, 2022). Thereby, the fashion industry belongs to the priority intervention area in the sustainability agenda.

Consumers have a critical role in the shift toward sustainable consumption patterns by adopting sustainable product choices, as well as sustainable use and

disposal behaviors (Peattie, 2010). Several scholars studied sustainable consumption by applying multiple theoretical approaches, theories, and investigating a plethora of factors affecting consumer behavior (e.g., Groening et al., 2018; Concari et al., 2020). Nowadays, literature interest in sustainable fashion consumption is rising. Several studies investigate factors affecting sustainable behavior, like purchase intention (Abrar et al., 2021; Chaturvedi et al., 2020), willingness to pay a premium price (Dodds et al., 2016; Stall-Meadows and Davey, 2013) for sustainable garments, as well as sustainable practices related to garments usage (Whitson-Smith, 2018; Laitala and Klepp, 2016), and disposal (Zhang et al., 2020; Joung and Park-Poaps, 2013). These studies are mainly focused on a single sustainable category (e.g., organic - Gam, 2011) or a single consumption phase (e.g., laundry - Laitala et al., 2012), conversely few studies considered multiple consumption stages simultaneously (e.g., Soyer and Dittrich, 2021).

However, several options to make the fashion industry more sustainable do exist. In addition, sustainable fashion options can belong to the garment choice (i.e., before consumer usage), the garment usage (i.e., during consumer usage), and garment disposal (i.e., after usage when the consumer ceases to use the garment) phase (Dangelico and Pontrandolfo, 2010).

Busalim et al. (2022) published a systematic literature review on sustainable fashion purchase behaviors. However, this study considers articles published till 2019 and is focused on methodologies and theories used and the evolution of the research over time. Other literature reviews concerning sustainable fashion have recently developed. Nevertheless, these reviews deal with a single aspect of sustainable fashion, such as consumer laundry practices (Klint et al., 2022), humans' perceptions of recycled textiles and circular fashion services (Wagner and Heinzel, 2020), collaborative fashion consumption (Jain et al., 2022), clothing recycling and reusing patterns (Xie et al., 2021). Conversely, a holistic approach analysis of sustainable fashion consumption (i.e., considering the phases of clothing purchase, use, and disposal together) is rare.

To the best of our knowledge, only one study systematically reviews sustainable fashion matters considering the life cycle of consumption (Vesterinen and Syrjälä, 2022). Nevertheless, a systemic approach is critical to fully understanding sustainable consumption (Ellen McArthur Foundation, 2017; Peattie, 2010). A holistic analysis of the determinants of consumer behaviour

toward the multiple alternatives to make, use, and dispose of fashion products sustainably available is missing.

For the above-mentioned reasons, and considering the critical role of consumers in the shift toward sustainable consumption, this paper proposes to systematically review sustainable fashion literature to fill the research gaps (e.g., Page et al., 2021). The following research question drives the paper:

> *Which factors influence sustainable consumer behavior in each of the consumption phases (i.e., purchase, use, and disposal)?*

The paper provides a picture of the motives that favor or discourage the adoption of sustainable behaviors, defines several future research directions, and it can be useful in developing marketing strategies. The structure of the paper is as follows. Section 2 presents the methodology. Section 3 presents the results reported according to the three consumption stages. Section 4 presents the conclusions, implications, and future research directions.

2 Methodology

To address the research question systematic literature review was conducted (Page et al., 2021). (1) Sustainability, (2) consumer behavior, and (3) the fashion industry are the three main domains from which relevant keywords to build the research query were identified. The keywords determined were mixed in a research algorithm using Boolean operators. Then the obtained research query was launched on 31st December 2022 in Scopus and Web of Science databases to search for relevant articles. Only articles published in peer-review journals and written in English were included. First, 536 articles from Scopus and 349 articles from Web of Science were found. After removing 291 duplicates, the starting sample was composed of 594 articles. The following inclusion criteria were considered in the article screening: (1) focus on the consumer perspective, studying behaviors and/or their determinants, (2) focus on sustainability, in terms of product characteristics and/or sustainable behaviors, and (3) focus on the fashion industry[1]. First, the article's titles and abstracts were analyzed, leading to the exclusion of 292 papers. Second, articles' full texts screening led to excluding other 86 papers. A final sample of 216 articles is considered for the review.

[1] *Articles dealing with shoes, accessories, and cosmetics were not included.*

From the obtained sample, data relating to various aspects (e.g., sample characteristics, product studied, consumption phase, determinants of behaviors) were extrapolated.

3 Findings

Concerning the sample characteristics, the articles were published between 1997 and 2022. Since 2016 a significant increase in the number of studies can be noticed. Papers have been published in 79 different journals. The studies involve consumers from 47 different countries. Countries with more studies are the USA, China, and Europe. In the early 2000s, studies mainly focused on consumers from North America and Europe. Since 2015, a significant increase in studies on Asian consumers has been reported. Most studies applied a quantitative research approach, while qualitative or mixed methods are less used.

Results are classified according to the product life cycle perspective, (1) garment choice (i.e., before consumer usage), (2) garment usage (i.e., during consumer usage), (3) ceasing to use the garment (i.e., after consumer usage) (Dangelico and Pontrandolfo, 2010).

3.1 Factors affecting sustainable garment choice

Within the selected sample, more than half of the articles analyze the phase of choosing a sustainable clothing product. Among these, both qualitative and quantitative methods are used.

The selected articles have analyzed consumers' choice of products belonging to six categories of sustainable garments: (1) recycled (apparel, wastes, generic material), (2) second-hand, (3) organic (crop, livestock, generic fibers), (4) bio-based, (5) slow fashion, and (6) generic sustainable garments.

Most of the studies investigated consumers' purchase intention (PI), while fewer focused on willingness to pay (WTP) and actual purchase behavior (PB).

A total of 95 distinct factors able to influence consumers' product choice behavior were identified. These factors are classified into three macro-categories, named (1) Consumers, (2) Marketing and Purchase, and (3) Social context, according to the classification proposed by Bangsa and Schlegelmilch (2020). These categories respectively concern the personal sphere of the consumer (e.g., attitude, values, feelings), the product attributes and the marketing strategy used

by the company (e.g., attributes, price, advertising, CSR), and the factors of external influence (e.g., social influence, celebrities, online communities).

Factors belonging to the Consumers category were divided into four subcategories.

1. *Values* - Here factors ascribable to the values categories defined by Schwartz (1992) are reported. The analysis shows that values related to openness to change (e.g., need for variety), to self-transcendence (e.g., altruism), and hedonism (e.g., consumption hedonism) have a positive effect on consumer PI, WTP, and PB toward several sustainable product options. Mixed results emerged for self-enhancement (e.g., authority and status) and conservation (e.g., frugality) values. Studies found both positive and negative effects on consumers' sustainable product choice behaviors.
2. *Environment* - Here factors related to consumer environmental beliefs are reported. Most of those factors were found to have a positive influence on sustainable product choice behavior (e.g., attitude, environmental concern, past experience with sustainable garments). Mixed results were found concerning consumers' perceived effectiveness and knowledge of both environment and sustainable garments. Here, although most studies have found a positive effect of these variables some have found negative effects. Further consumers who are used to adopting sustainable consumer behaviors have higher intention to purchase and pay a premium price, as well as a higher actual purchase of sustainable garments.
3. *Control* - Here factors concerning the consumers' capabilities to perform the behavior are reported. Perceived behavioral control is the most commonly used factor, some studies introduce other factors ascribable to this subcategory (e.g., perception of availability). The effect of these factors on sustainable consumer behavior was found to be positive for several product categories except for organic garments for which mixed results emerge.
4. *Fashion* - Here factors related to the importance consumers attribute to the fashion industry and the fashion garments in their lives are reported. Factors belonging to this category (e.g., fashion interest) were studied only for a restricted set of sustainable garments, particularly for slow-fashion garments. The effects on sustainable

garment choices are mainly positive, except for some cases in which no significant effects are found.

Factors belonging to the Marketing category were divided into two sub categories.

1. *Product* - Here factors related to product features (e.g., quality) and consumers' perception associated with the product (e.g., perceived risk) are reported. Results show that factors related to product features positively impact consumer choice behaviors toward several sustainable garment categories. Concerning consumers' perception, the review revealed that perceived risk and skepticism have a negative effect on sustainable garment purchase behavior.
2. *Marketing and sustainability strategies* - Here factors related to the firm's marketing and sustainability strategies are reported. Here factors related to the firm's marketing and sustainability strategies are reported. Results show that factors linked to promotion (e.g., visual and verbal nudges), sustainability firms' efforts (e.g., corporate social responsibility), and store attributes (e.g., efficient customer service) have a positive effect on consumer purchase behavior toward several sustainable garment categories.

Factors belonging to the Social context category were divided into two sub categories.

1. *Non-digital specific* - Here factors related to the social forces able to influence consumer behavior (e.g., social norms) are reported. Results show the positive impact of those factors on consumer purchase behavior toward several sustainable garment categories. However, mixed results are found concerning slow fashion and organic garments categories, with some scholars reporting no significant effect of those factors on purchase choices.
2. *Digital specific* - Here factors related to electronic consumers' interactions (e.g., social media influence) able to influence purchasing behavior are reported. The effect of those factors on consumers' purchase behavior was found to be positive across several sustainable garments categories.

Furthermore, several studies have investigated consumer behavior through a qualitative approach, mainly focusing on generic sustainable garments. Four main barriers to sustainable garments purchase emerged from the review.

1. *Price* - Sustainable garments are perceived as more expensive compared to unsustainable alternatives, and several consumers judge those products as not affordable in terms of price.
2. *Skepticism* - Consumers might have low trust in firms' sustainability declarations due to a lack of transparency and misleading language used in product descriptions and environmental declarations.
3. *Knowledge* - Consumers' lack of knowledge of sustainable garments might cause negative product perceptions and efforts in identifying them.
4. *Availability* - Consumers' perception of the low availability of sustainable garments might be associated with difficulty in finding the product.

Concerning factors motivating sustainable fashion consumption, the review shows three main factors playing a critical role in consumers' decision-making process. Affordable prices, high quality (e.g., high comfort clothing), and captivating aesthetics (i.e., fashionable style) favor consumers' choices toward sustainable garments. In addition, results show that sustainable product attributes have secondary importance in consumers' purchasing choices. Recent studies demonstrated the effectiveness of digital tools (e.g., social media) in spreading sustainable fashion knowledge and practices among consumers.

3.2 Factors affecting sustainable use of garment

Concerning sustainable garment usage, it can be possible to distinguish between personal and collaborative fashion usage.

Personal fashion use refers to clothing maintenance and care. Sustainable practices of garments usage are linked to product life cycle extension strategies like continuing to wear garments, repairing defects, and careful laundry. Barriers toward the adoption of those activities are lack of knowledge on how to carry out them, low quality of garments that causes shorter use and lower maintenance, and social pressure to update and change outfits regularly to not incur negative perceptions like being dirty or out of fashion. Conversely, motivators toward sustainable usage practices concern the high quality of the garments, emotional attachment, and the accessibility of services such as repair and laundry services and style consultancy.

Collaborative fashion usage refers to sharing clothing among users and having access to garments instead of owning them, e.g., through renting.

Factors reducing consumers' willingness to participate in collaborative forms of clothing usage are the reduction in consumers' perceived ability to express themselves derived from not owning the garment, lower comfort and lower quality of garments, limited availability, and scarce flexibility of the rental period. Drivers to collaborative fashion use are the sense of belonging in a community perceived, having access to exclusive clothing items, the purpose of adopting more sustainable consumption choices by extending the product life cycle and reducing new purchases.

3.3 Factors affecting sustainable disposal of garment

Garment disposal refers to the cease of using the garment by the consumer (e.g., the consumer considers it obsolete and does not wear it anymore). Several disposal options do exist, such as donating to charity and recycling.

Barriers toward sustainable disposal are the low quality of garments, serious damages, and specific clothing items (i.e., underwear and socks). Generally, clothing with those characteristics is thrown away unsustainably. Further, the perceived lack of knowledge of recycling services and how to perform sustainable disposal are other barriers to sustainable behaviors.

Conversely, high-quality, expensive, and famous brand garments as well as mono-material composition and modular clothing favor consumers' sustainable disposal practices.

4 Conclusions

This systematic review analyzed the sustainable fashion consumption phenomenon by analyzing 216 articles. The output is a picture of the factors affecting sustainable consumer behaviors among the three consumption stages.

Consumers value mainly the style, quality, and comfort of garments. Marketers should ensure they offer garments with these characteristics to favor sustainable consumption and extend clothing usage. Providing clear information about environmental product features and promoting sustainable ways to use and dispose of clothing is critical to increasing consumer knowledge of sustainable consumption behavior, thus reducing perceived skepticism. Collaborative consumption is a critical sustainable consumption alternative firms should make

efforts to foster accessibility to this service. Nowadays, digital tools (e.g., metaverse simulation) adoption for promoting sustainable behaviors is increasingly widespread in business-to-consumer and consumer-to-consumer relationships and deserves further investigation.

This review highlights several avenues for future research. Since most articles focused on generic sustainable garments and contrasting results are reported for different sustainable categories (e.g., organic vs recycled garments), future studies could compare garments with distinct sustainable attributes. Articles on garments made with new-generation materials (e.g., bio-based) are rare; hence, scholars should further investigate consumer behavior towards those products. The lack of knowledge and availability of sustainable products and services are strong barriers to the diffusion of sustainable consumption practices. Scholars should deepen the analysis of factors able to help consumers in overcoming those barriers. Several strategies to use and dispose of clothing sustainably do exist. Scholars should further analyze influencing factors of consumer adoption behaviors toward these options, such as product type, trust in suppliers, and service accessibility.

Concerning study limitations, only the Scopus and Web of Science databases were analyzed while other relevant articles outside these databases could be missed. Furthermore, this review does not include articles focused on shoes or accessories, relevant findings could be missed. This study is conducted from the consumer perspective: future research could integrate the results with the company perspective.

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Reconstruction of Models. Models of Reconstruction.

Pietro Brunazzi

Department DAStU
Politecnico di Milano
Piazza Leonardo da Vinci, 32 20133 Milano

Abstract

The traditional concept of heritage, which focuses mainly on physical, architectural and urban aspects, no longer allows adequate conservation strategies. New approaches need to integrate notions of the socio-economic context and sustainable development as well as factors related to social and cultural representations and intangible heritage. Reconstruction is the activity of building again something that has been damaged, bringing it into the state it was before; nevertheless, deeper studies, focused on what reconstruction is, show how it doesn't only describe a project but it also sums an attitude of mind in the face of lack of form, defined by scientific, ideological and political strategies, economic interests, aesthetic demands

The controversial topic must be led out of fixed patterns of thought, as it has ceased to be simply the continuous representation of an image, instead shifting the paradigm towards a new construction of history. The ever-present idea and practice of re-presenting again what is missing must be seen in the new perspective of "re-construction", stressing the attention on the prefix "re-", linked to the possibility of repetition of actions, in same or opposite way, moving expected results from precise copy to broader quote of invention. The basic principle of any cognitive structure is repetition. If intended as the action of performing again something that already occurred, it allows the formation in the subconscious of an image in which users can recognise specific values. Reconstruction, in the action of building again and filling gaps, supports the desire for continuity of a constructed memory that is also part of contemporary cultural self-construction. The concept of reconstruction weaves relationships concerning ontological, ethical and pragmatic aspects. Reconstruction tackles the dichotomy between complete form and ruins, a condition in which architecture, although reduced to minimum formal terms, still manages to exist through an image that constantly lies in collective memory. It opens questions on the ratio between original contents and replicas and on its social and political legitimacy and investigates building techniques involved and the innovation impressed on the remains by the rehabilitation project.

This contribution aims to clarify how a reconstructive approach to heritage intervention can play, in multiple fields, a significant role in the transmission of memory and value, and also to broaden the spectrum of investigation onto various reconstructive models, which provide the theoretical basis for a subsequent practical approach for the heritage.

Keywords – Reconstruction, model, ruins, value, Verona

Paper type – Academic Research Paper

1 Considerations on a new approach to reconstruction

> *«Since the pre-Roman period, a fortified settlement has existed on the hill where Carcassonne now stands. In its present form it is an outstanding example of a medieval fortified town, with its massive defences encircling the castle and the surrounding buildings, its streets and its fine Gothic cathedral. Carcassonne is also of exceptional importance because of the lengthy restoration campaign undertaken by Viollet-le-Duc, one of the founders of the modern science of conservation*[1]*.»*

The dossier accompanying the 1996 candidature of the "*Ville historique fortifiée de Carcassone*" for UNESCO World Heritage Site highlighted not only the importance of the Fortified City of Carcassone, as an example of a fortified medieval citadel whose defence system was founded on a fortified structure dating back to the late antique period, but also the role of Viollet-le-Duc and the restoration works he undertook in the XIX century, were remarked of fundamental importance. A crucial aspect regarding the inscription of the Carcassone site was the cultural change that occurred in the early 1990s regarding the concept of authenticity. In particular, the revision by ICOMOS of the perception and definition of the term "authenticity" represented a new opportunity with respect to the inscription of the property, which had been rejected in 1985.

New interest in the concept of authenticity is due to the 1994 Nara Document of Authenticity which, though conceived in the spirit of the Venice Charter, expands the interest and concerns for cultural heritage in contemporary world, mostly elaborating the concept of "authenticity" in ways which accord full respect to the social and cultural values of all societies, in examining those Outstanding Universal Values of cultural properties, which are crucial for the inscription in the World Heritage List. The new vision of the concept of authenticity recognises restoration not as an element of falsification but rather of value. Our ability to understand these values depends, in part, on the degree to which information sources about these values may be understood as credible or truthful. Knowledge

[1] *https://whc.unesco.org/en/list/345/*

and understanding of these sources of information, in relation to original and subsequent characteristics of the cultural heritage, and their meaning, is a requisite basis for assessing all aspects of authenticity. From this perspective, the reconstruction project intervenes as a medium for a translation (from latin *traducere,* bringing beyond) and recomposition of an architectural text that would otherwise be indecipherable and unrecognisable. A reconstruction is not a falsification or a forgery or pastiche. It is a ritual that allows the conservation and transmission of local building culture from generation to generation[1].

The later 2000 Riga Charter[2] states that "the purpose of conservation (and/or reconstruction) is to maintain and reveal the significance of the cultural heritage" (Article 3) and that "in exceptional circumstances, reconstruction of cultural heritage, lost through disaster, whether of natural or human origin, may be acceptable, when the monument concerned has outstanding artistic, symbolic or environmental (whether urban or rural) significance for regional history and cultures" (Article 6). At the beginning of the 21st century, the way is thus set for a project that is the ultimate result of a reconstructive act of thought. In fact, faced with the loss of an architecture that made sense for the existence of an individual man or a community, the only possible act to restart is to attempt to put the form back in its place: in its original spirit, in its design, in its volume, in its essence.

2 When and where does reconstruction occur? Architecture in ruin

The valorisation of architectural heritage must be aware of the possibility of ruin, seen as extreme moment in architecture life-cycle. The work of architecture can be seen as a moment of balance, meticulously planned and designed by the hand of the architect, in which the weight and load-bearing power of matter and the action of the forces of nature, which act and respond on that matter, are equivalent. Ruins occur when the original form fails due to natural events, such as calamitous disasters and the effects of the inexorable flow of time, to events derived from the voluntary and aggressive action of man or his negligence, in the case of abandonment. As a result, the architectural landscape faces a multitude of wandering forms, waiting to find sedimentation, recognition and narrative. Within this framework of ensuring the identification, protection and transmission to

[1] *Roha W. Khalaf (2017) A viewpoint on the reconstruction of destroyed UNESCO Cultural World Heritage Sites, International Journal of Heritage Studies, 23:3, 261-274, DOI: 10.1080/13527258.2016.1269239*
[2] *https://www.iccrom.org/sites/default/files/publications/2020-05/convern8_07_rigacharter_ing.pdf*

future generations of the cultural heritage, architecture proposes an intervention on the built heritage when its state of preservation impairs its complete understanding through a reconstruction project.

The reconstruction project does not foresee an a priori result; rather, based on a case-by-case situation, it moves from the recomposition of a few fragments up to reconstruction *à l'identique*, based on the study of each case and looking forward to the result that best suits the need for management and transmission of the knowledge and value inherent in the built form. Archaeological and built heritage is a worldwide shared asset, hence the need for each legislation to guarantee its preservation. In some instances, we face genuine problems of culture, which is why it is essential to create a correct perception of the value of specific sites, starting with the sites themselves. By reconstructing lost, disappeared or even incomplete buildings, architects measure themselves against a very particular aspect of the relationship between old and new. Reflecting on the ruins involves formulating a thought about what has passed and a category of the existing: that of the rest, which poses the urgency of setting up a possible relationship between us and this heritage.

3 Memory and models

The concept of cultural memory concerns the external dimensions of human memory. We tend to imagine memory as a purely internal phenomenon, located in the individual's brain, and thus the subject of cerebral physiology, neurology and psychology, but not of the historical sciences of culture. Yet the contents of this memory, the way it organises them and the length of time it manages to retain something are to a very large extent a matter not of controlling inner capacities, but of external, i.e. social and cultural, framework conditions. It is oriented on the basis of fixed points in the past, despite the fact that the past is not able to preserve itself as such, but rather coagulates into symbolic forms to which memory is attached. Memory thus becomes a cultural factor and, as such, is linked to the transmission of meaning. This transmission can take place within a connective structure that act within the social and temporal dimensions establishing bonds and connections. What binds individuals together is the connective structure of a common knowledge: this structure is based on the one hand on the binding of common rules and values and on the other on the memory of a shared past. Cultural memory is not transmitted by biological

inheritance. It must be kept active culturally, through the succession of generations. This is a problem of cultural mnemonics, i.e. memorisation, reactivation and, indeed, transmission of meaning. Textual coherence involves the production of a reference horizon that goes beyond the inherent fractures.

The didactic and valuable objective of the complete transmission of knowledge cannot be separated from the ability of everyone to comprehend heritage objects. Above all, reconstruction is a transcultural medium. Especially when heritage is in a state of ruin, it is necessary to undertake an operation of restitution of meaning: architecture already exists as a lexicon, the result of shared codifications transmitted over time. Architecture transcends mere form by becoming a model, a prototype resulting from conventions between tradition and the architect, or dictated by the geomorphological configuration of sites, the climate and the technical evolution of building customs. The character of iconic model requires that interventions respect a particular lexicon, a shareable code necessary for transmission of meaning. Architecture expresses itself through languages intended for communication that imply the use of a code between the communicator and its users, between the subjects and society or institutions. Belonging to a lexicon allows its repeatability since adherence to a certain code enables its reuse in different times. Reconstruction then intervenes in the transtemporal dimension of ruins, which can be seen as places of collective memory: in fact, as a vector of memory, ruins actively link the past to the present in view of the future, and their preservation must be understood as a modern phenomenon of maintaining living contact with the cultural works of the past. The canonical notion of heritage thus expands to that of heritage landscape, in which one or more different values can be recognised: aesthetic, historical, social, evolutionary, but also mythical or legendary. Valorisation stems from recognising a principle of symbolic value, which varies according to different national and regional contexts and for which it is difficult to impose mechanistic formulas and standardised procedures. Reconstruction guarantees access to knowledge linked to the form of the heritage, acting on a double temporal register: both at the level of the present where knowledge is linked to the possibility of reading and studying the heritage, and at the level of the future where the maintenance guarantees the transmission of knowledge over time of an architectural form imbued with meaning.

To clarifying the vast panorama of reconstructive possibilities the discussion can identify some intervention models. We can consider as a 'model' any real

object that is taken as a reference, in a more or less direct way, to outline the practices and actions to be taken for the realisation of another object that is the same or has similar characteristics. The term refers to a broad class of hypotheses and complex constructions with which the object of research is represented, through which it is proposed to organise data and knowledge, but also to experiment further, and then interpret, explain, generalise and compare. The choice/preference characterizing each intervention must be sought in the variables of the project (e.g. the state of the ruins, the desire to transmit values, the possibility of intervening on the site, the level of legislative constraint placed on the site considered, ...) with the ultimate intention of bridging the gap between the visible condition of the ruins and the invisible one of the original form. These models propose a diversified approach to each project: depending on the individual case, it may restore an architecture down to its last detail or maintain it in its state of ruin, although additions that clarify its original conformation may be taken into consideration, or it may intervene with a greater degree of invention freedom, depending precisely on the initial state of conservation, and propose new articulations aimed, in each case, at reading the original spatiality of the work.

4 Verona and its reconstructions

The events related with Verona's architectural and urban system from the beginning of the XX century onwards certainly represent an interesting case study, both in terms of the interventions to protect monuments and city fabric and the debate that accompanied them, led by architects such as Libero Cecchini and intellectuals such as Piero Gazzola.

In 2000 the historic city of Verona was inscribed in the UNESCO WHL, standing out as a city of culture and art, which preserved a remarkable amount of monuments from antiquity and the medieval and Renaissance periods, and represented an outstanding example of a military stronghold. Particularly interesting is the ICOMOS Evaluation Mission dossier, occurred in January 2000, which, speaking of "authenticity" reported:

> *«The City of Verona retained its historic fabric completely intact until the 1882 flood and World War II, which caused a large amount of damage. Since then, the city has been subject to restoration and reconstruction, which was done with great care and respecting the historic fabric. At the*

present time, Verona still displays an exceptional amount of Roman remains, and its Roman origins are also reflected in its street pattern. The particular significance of Verona lies in the continuity of its military use, and the defence system has been well preserved. In the 20th century, the urban fabric has expanded beyond the city walls, but the natural setting of the town is still of outstanding quality, and is fully protected. The historic city of Verona can thus be considered to fulfil the requirements of the test of authenticity.[1]*»*

This report recognised the role of city reconstructions in conveying and safeguarding the image and value of the historic city through time; value that, in some cases, is transmitted through reconstructed architecture. Specifically, the reconstructions undertaken in the XX century serve as paradigmatic examples to recognise certain operational models for the project.

Anastylosis: it is the reconstruction of an architectural artefact, in accordance with the canons of architecture with orders, using only its original parts, found on site. Noteworthy is the Arch of the Gavi, located along the ancient Via Postumia, a rare case of an honorary and monumental arch for private use in Roman architecture. It was in fact, built around the middle of the I century to celebrate the *gens Gavia*. During the Renaissance, this was one of the most appreciated of Verona's antiquities, also due to the presence of the signature of a Vitruvius, recalling the famous Roman architect and author of the treatise *De Architectura*. The monument was then described by humanists and antiquarians, reproduced in detail and studied in terms of proportions and decorations, and finally taken up as a model by architects and painters, such as Andrea Palladio, Antonio da Sangallo, Sebastiano Serlio, Michele Sanmicheli, and even Andrea Mantegna. He had a great influence on Veronese art in particular, copying the overall scheme for the construction of portals, altars and chapels in the main churches of Verona. In 1805, during the Napoleonic occupation, the French Army Corps of Engineers decreed and implemented the dismantling of the monument for reasons of military safety and viability: the arch was then carefully surveyed in all its stone elements and decorations so that it could be reconstructed later, it was dismantled and the blocks were finally deposited in the archways of the Arena. At the beginning of the XX century, the inspector of monuments, Antonio Avena proposed its reconstruction and recomposition, encountering heated controversy

[1] *https://whc.unesco.org/document/154298*

over the location in which to reconstruct it and the method of restoration. The final project, supervised by the archaeologist Carlo Anti, recomposed the arch using all the original pieces, with a few additions of materials that were in any case treated with hammering to disguise its ancient appearance, but envisaged a new location in a square adjacent to Castelvecchio, a few metres from the original site, respecting the city's evolution that took place between its dismantling and reconstruction.

Pseudo-anastyilosis: is so defined because it concerns cases of architecture reconstruction that do not conform to classical orders. It is carried out by anastylosis of a few surviving originals, thus providing for a large presence of pieces of new craft but reintegrated to disguise the ancient appearance. A symbol of this model in the Veronese panorama is the reconstruction of Ponte Pietra. The bridge represents a typical example of the symbiosis of the architectural dimension with the environmental one, because the grafting of a mediaeval structure onto a Roman construction is relevant, to which is added the picturesque effect of its position in the landscape, territory and history. Following its destruction, together with the city's other bridges, on 24 April 1945, superintendent Piero Gazzola could only salvage the few intact debris and arrange the riverbed, postponing reconstruction. The elimination of Ponte Pietra in the aftermath of the wartime destruction or its replacement with a modern artefact would have cost the sacrifice of the character of a vast area and would have compromised the general physiognomy of Verona itself, lacerating its delicate aesthetic texture. To avoid this deplorable result, the problem of recomposing the ancient artefact was tackled, proceeding from what had been saved by anastylosis. Before the project was completed, all the original materials of the bridge were recovered, studied and catalogued. This was followed by the restoration of the few surviving portions: the left bank abutment and parts of the first and second piers on the right bank. The building site, supervised by architect Libero Cecchini, began only in 1957, using the original pieces recovered together with new stone elements extracted from quarries in the Verona area and deliberately aged to disguise the bridge's pre-war appearance, to restore the original urban landscape.

In vitro reconstruction : this model, generally for exhibition/museum purposes, is based on an awareness of the fragility of the artefact, which is no longer capable of guaranteeing the necessary static balance. The reconstruction project envisages the dismantling of the artefact and its new relocation on a host

structure. The latter recomposition can take place within a protected and controlled museum system (e.g. Pergamon Altar moved from its original site in Asia Minor and now placed in display inside Pergamon Museum in Berlin) or can take place externally, using a supporting architectural structure, thus ensuring the continuity of the urban role of architecture. This is the case with the façade of the Church of San Sebastiano, which was relocated on the body of the Church of San Nicolò all'Arena. The bombing of 4 January 1945 destroyed the entire complex of the Church of San Sebastiano, of which only the façade remained standing, which had tilted forward due to the air displacement, with the risk of falling ruinously onto the building in front of it. As an extreme protective solution, the Superintendency gave up on the reconstruction of the Neoclassical church, deciding to dismantle the surviving façade and reuse it to complete the unfinished, Baroque church of San Nicolò: as it was not, where it was not. The work of dismantling and recovering the stone elements took place after a meticulous inspection and survey of the façade. For the times, this was a technically and theoretically extreme project, eschewing any philological criteria of which Piero Gazzola was aware. In fact, the project forced the gable to be doubled and the side openings of the façade to be moved. Nevertheless, the final result guaranteed, similarly to the case of Ponte Pietra, the recomposition of a controlled and designed city architectural environment.

Logical/inventive reconstruction: example of this model is the project for Castelvecchio Museum by Carlo Scarpa, famously regarded as one of the greatest examples of Italian museography in the second half of the 20th century. The restoration of the Scaliger castle took place at a time of heated debate on the reconstruction of the city of Verona and its monumental heritage, which prompted the architect to develop a working method that was exemplary. Castelvecchio was not seriously damaged by war raids, but had been heavily remodelled by two phases of restoration during the Napoleonic era and at the beginning of the 20th century. Starting from the recognition of arbitrary additions, he carried out some necessary demolitions to highlight the original parts by means of special devices such as open windows in the floor or cuts that allow the successive stratifications of the monument to be read. This is flanked by the conception of a unified museum itinerary, at times happily interrupted by excursions to the outside, and completed by an essential and rigorous set-up system that visually connects the works, reaching its high point in the display of the equestrian statue of Cangrande I della Scala. Unprecedented are the

juxtapositions of ancient materials such as stone and wood brought closer to modern ones such as concrete left exposed or sometimes treated with traditional techniques such as bush-hammering, or the revisiting of ancient techniques such as the coloured stucco treatment of some surfaces, interpreted in a modern key. Carlo Scarpa here reconstructs the entire history of Castelvecchio in a single project, certainly applying a greater inventive quotient than the models seen previously.

5 Concluding remarks

The case history of monumental architectures reconstructed in whole or in part to put an end to their state of lying in ruins or to their state of un recognisability is generally driven by the desire to restore a monumental architecture, felt as collective heritage, to a corporeal reality without which it would be a pure ghost. These examples are not only theoretical sources of study but are also to be taken as operational models. From the treatment of the few cases cited here, however, emerges a vocation for the trans-disciplinary nature of the heritage reconstruction project: the ethical-social will of reconstruction must necessarily interact with the precepts of monument conservation and the technical-operational needs of the project, with a continuous confrontation between scholars, technicians and the community.

A post-conflict and post-disaster approach to reconstruction became an increasingly important issue after the destruction of cultural heritage sites and monuments. Study, recognition and development of these models within proactive cultural frameworks can address the multi-faceted challenges of reconstruction.

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The Mediating Role of Information Integration Capability between Digital and Human Resources and Resilience Performance

Cristina De Luca*

Department of Mechanics Mathematics and Management,
Polytechnic of Bari
Via Orabona 4, 70125 Bari (Italy)

Nunzia Carbonara

Department of Mechanics Mathematics and Management,
Polytechnic of Bari
Via Orabona 4, 70125 Bari (Italy)

Roberta Pellegrino

Department of Mechanics Mathematics and Management,
Polytechnic of Bari
Via Orabona 4, 70125 Bari (Italy)

* *Corresponding author*

Abstract

In light of recent disruptive events, it is necessary to expand knowledge on how to improve the resilience of healthcare systems. Recent literature on resilience in healthcare considers intra- and inter-organizational collaboration and cooperation as the winning capability for achieving hospital resilience performance. According to the supply chain information integration literature, both collaboration and cooperation depend on integration factors such as knowledge and information sharing within the organizational functions and across the supply chain partners.

Adopting the perspective of resource-based view, a research model reporting resource-capabilities-resilience performance linkages is proposed. This study divides the information integration capabilities in two dimensions, the internal and the external and regarding resources, it considers the digital and human resources as allowing healthcare organizations to develop integration capabilities and obtain resilience performance. The paper intends to investigate the impact of digital and human resources on resilience performance and, moreover, the mediating role of supply chain information integration capability in the relationship between human and digital resources and resilience

performance is also considered. This study intends to test this model conducting empirical research which will be based on survey data collected from Italian hospitals. Structural equation modelling methods will be used to test the proposed relationships. This study contributes to the supply chain information integration literature investigating the healthcare sector and provides managerial implications for hospital and healthcare supply chain managers to properly leverage resources and capabilities with the aim of obtaining resilience performance.

Keywords – Supply Chain Information Integration **–** Resilience – Healthcare – Digital resources – Human resources

Paper type Practical Paper

1 Introduction

Recent disruptive events have exposed the healthcare industry to risks and uncertainties that have compromised and severely hampered the overriding objective of providing care for patients, resulting in blockages in the flow of goods and services.

Resiliency is considered an effective way to withstand and recover from major disruptions and mitigate their impact in organizations and supply chain (Achour et al., 2022; Alameddine et al., 2019).

To develop resilience capabilities such as flexibility, agility, visibility and adaptability, healthcare organizations are called to reconfigure and reorganize their resources (Ambulkar et al., 2016). As for the recent pandemic, to control disruptions, hospitals need to reconfigure and acquire both tangible and intangible resources such as remote and digital technologies and human skill-set capacity which include not only technical know-how but also relational behaviours (Alan et al., 2022; Tonetto et al., 2021). These resources enable healthcare organizations to standardise new procedures and tasks redeploying health professionals or creating new roles with specific job description and including unusual healthcare professions in the hospital worker force (Veerapen and McKeown, 2021). All of these initiatives are heavily supported by cross-functional cooperation and coordination activities (Donelli et al., 2022; Sacoor et al., 2020).

In situation of high uncertainty, healthcare organizations are unable to manage complex crisis independently but depend on external network partners to acquire

valuable information, knowledge, and complementary resources, enhancing their ability to respond promptly to patient's needs (Kamalahmadi and Parast, 2016).

For example, collaborative networks in healthcare were established, creating relationship in the form of coalitions, collaborations, consortia, expertise sharing between hospitals to improve the quality and the efficiency of the delivery services (Jiang *et al.*, 202; Mervyn et al., 2019; Hines and Reid, 2021). Furthermore, many countries developed coordination mechanisms at the regional level to distribute available resources and collect information (Winkelmann et al., 2021; Jamal et al., 2019).

In their case study, Spieske et al. (2022) found that that several hospitals established boundary-spanning activities such as information sharing and forming of alliances, with the aim of reducing uncertainty and improve supply availability.

In this vein, managing collaboration between the intra- and inter-organizational processes enable healthcare organization to be more likely to withstand and quickly respond to crises or, in other word, to be resilient (Iflaifel et al., 2021).

Both collaboration and cooperation activities rely on integration factors such as information sharing, cross-functional teams, adequate communication which are concepts discussed in the supply chain information integration (SCII) literature (Poberschnigg et al., 2020; Huo et al., 2016).

While the post-pandemic qualitative research has demonstrated the importance of collaborative practices and the literature acknowledges the importance of inter- and intra-organizational information sharing activities, there have been no attempts to demonstrate the role of information integration for resilience, particularly in the healthcare sector.

Grounded on the resource-based view theory (RBV) this study seeks to better understand the relation between resources, capabilities and resilience. The RBV posits that strategic resources and capabilities can help organizations and their supply chain to achieve better performance, including resilience (Chahal *et al.*, 2020; Aragón-Correa and Sharma, 2003). In particular, in terms of resources, this study focuses both on tangible and intangible resources including digital technologies and human skill-set capacity. The digital technologies include all the interconnected digital applications, electronics, and microstructure technologies which leverage the main baseline technologies of IoT, big data, and cloud computing. Concerning intangible resources referring to skills and competencies,

this study refers to the technical know-how, skills, education, training and team-skills of medical personnel, and expertise of hospital procurement department employees. The RBV posits that, developing an effective and efficient process of combining these resources, hospitals are able to produce capabilities and create value. Among the capabilities, information integration refers to the ability to acquire and share information within the organization and along the supply chain.

Overall, our study intends to enrich the understanding of how the information integration capability could explain the impact of the resources, tangible and intangible, has on hospital resilience.

2 Theoretical background and hypotheses

2.1 Supply chain information integration

Recent disruptive events have caused organizations to rethink the need for cooperative supply chain partnership and joint improvement of inter-organizational processes. The supply chain integration is a stream of Supply Chain Management research which properly examining collaborative relationship between organizations and external actors (Ralston et al., 2015). If integration is essential to achieve effective and efficient flows of products, services, and decisions, the information integration in supply chain is beneficial to improve performance (Harland et al., 2007). Strategic information sharing within organizational functions and across supply chain partners results in a better management of intra- and inter-organizational processes (Huo et al., 2016). Information integration comprises two key elements: the information sharing and the collaborative planning. Information sharing refers to the exchange of critical information between supply chain members through the IT infrastructure such as telephone, mail, internet (Cai et al., 2010). Effective information sharing significantly enhanced supply chain practices. Collaborative planning complements the information sharing as it refers to collaboration among partners to develop operational and strategic planning (Petersen et al., 2005). As supply chain integration involves inter-organizational and intra-organizational interfaces that facilitate coordination and the effective flows of material, money, decisions, in a similar manner, the supply chain information integration should be divided into external and internal information integration (Zhao et al., 2011). External information integration is concerned with a closer collaboration and information

sharing with customers resulting in strategic insights of market opportunities and expectations and a closer cooperation and information sharing with supply chain members which provide insights for effective planning and process design (Schoenherr and Swink, 2012). In contrast, internal integration refers to the collaborative and information sharing mechanisms implemented between internal functions. Inter-functional communication and collaboration enable the utilization of each function's strengths and competences, highlighting the functional interdependencies (Pagell, 2004). Moreover, the internal information integration improves the recognition, dissemination and application of knowledge and information gathered through external information integration (Koufteros et al., 2010; Flynn et al., 2010). Internal information integration mainly involves data and information system integration through the use of operational data which guarantees synchronized and manageable processes (Zhao et al., 2011).

2.2 Supply Chain resilience

Since the 2000s, supply chain resilience has become a popular topic, but its definitions vary in the literature and surround different conceptualizations influenced by other domains such as engineering, psychology and ecology. In one of the earlier definitions, resilience in SC context was linked only to the reaction/response and recovery phase in order to maintain core operational functions after a disturbance occur (Rice and Caniato, 2003). Drawing from the resilience definition in the ecological field, the literature emphasized not only the ability to withstand the crisis and restore the original state but also added the growth phase which refers to the ability to move into a new, more desirable state after experiencing a disturbance (Christopher and Peck, 2004; Pettit et al.,2010; Ali et al., 2017; Brandon-Jones et al. 2014). The definition for supply chain resilience used in this paper is: *Supply chain's ability to be prepared for unexpected risk events, responding and recovering quickly to potential disruptions to return to its original situation or grow by moving to a new, more desirable state in order to increase customer service, market share and financial performance"* (Hohenstein et al., 2015, p. 108). According to the literature, the supply chain resilience encompasses five dimensions, namely the ability to *anticipate* unforeseen disruptive events, to *adapt* and withstanding disruptions, to *respond* quickly to disruptions, to *recover* from disruptions, returning to steady-state conditions, and

to *learn* from what has been done and anticipate future failures (Ali *et al.,* 2017; Duchek *et al.,* 2020; Lundberg. and Johansson, 2015).

2.3 Effects of digital resources on resilience

Digital resources describe information and communication technologies derived from Industry 4.0 which have been adapted to support healthcare treatments and administrative processes (Marques da Rosa et al., 2021). The digital technologies enable interconnection of processes, services and people, allowing organizations to build resilience capabilities such as visibility and flexibility. Some recent studies state that digital technologies are beneficial to resilient performance in hospitals (Chowdhury et al., 2021; Rusinko, 2020; Zhang and Qi, 2021). It is due to the fact that digital technologies, in the form of applications such as digital platforms, facilitate both supplier and cross-functional relationship management and allow real-time identification of trends in materials, equipment, processes increasing situational awareness and enhancing the hospital ability to anticipate the potential risks and disruptions (Tortorella et al., 2022). Moreover, digital applications facilitate the development of the remote communication with suppliers, in order to address issues in material, equipment, processes and patients, and thus enhance the hospital ability to adapt and respond to disruption (Marques da Rosa et al., 2021).

Hence, we propose:

H1. Digital resources are positively related to resilience performance.

2.4 Effects of human resources on resilience

Human capital plays a significant role in building resilience and could determine if organizations and supply chain develop the ability to adapt and to respond to change (McManus et al., 2008). Human resources describe all the skill-set capacity of both medical and administrative personnel, encompassing competences, experience as well as soft skills of teamwork and collaborative behaviour. Several competencies and skills emerge as being important for healthcare organizational performance and resilience in time of adversity (Juvet et al., 2022). In particular, hospitals enhanced the ability to respond by leveraging specific knowledge and experience of medical personnel in managing the emerging pandemic-driven intensive care. For example, teams of specialist nurses

and physicians were created to assist and manage the urgent situation combining technical abilities and leadership (MacKinnon *et al*., 2022; Ladak *et al*., 2021). Moreover, competences and experience of dentists and medical researchers revealed their utility in dealing with infection control procedures and, for this reason, these unusual health professions were included in the health worker force, improving the ability to adapt and react on time and efficiently in front of the disruption (Sacoor et al., 2020). Finally, the skills and experience of the procurement department employees allow hospitals to react and respond to the shortage of materials and equipment. They identify alternative source of supply and implemented new procurement initiatives (Spieske et al., 2022).

Therefore, we propose:

H2. Human resources are positively related to resilience.

2.5 Effects of digital resources on supply chain information integration

The digital resources implemented in healthcare organizations enable communication and promote different ways of interacting and disseminating health-related information (Tortorella et al., 2022). Digital applications including digital platforms or electronic database with patient real-time information, data sharing systems were considered as means for fostering effective information and communication sharing across the hospital. Therefore, digital technologies contribute to organizational collaboration and have improve internal information integration (Deveraj et al., 2007). In a similar manner, digital technologies referring to supply chain applications enable the management of materials, products, and equipment facilitating inter-organizational communication and collaboration (Harland et al., 2007). Moreover, digital resources are also used to collect data from operational processes in order to share information about supply chain problems and solve them (Huo et al., 2016). Therefore, digital resources can also improve external information integration.

Hence, we propose:

H3. Digital resources are positively related to (a) internal information integration and to (b) external information integration.

2.6 Effects of human resources on supply chain information integration

The skill-set capacity of medical and administrative staff also includes the confidence in working in team, collaborative behaviours, communication and trust (Alfalla-Luque et al., 2015). This kind of skill-set can promote high level of information sharing between hospitals functions and enhance internal information integration resulting in both formal coordination mechanisms, such as protocols and guidelines, and informal collaborative relationships among staff members (Ree *et al*., 2021; Forsgren *et al*., 2022). Moreover, this relational capacity promotes also the ability to manage supplies, establish cross-hospital partnerships and long term relationship, coordinate the supply network (Lyng *et al*., 2021; van den Berg *et al*., 2023). The cross-hospital relationship is not just a matter of redistributing patients, but also leads to the creation of alternative sourcing through the so-called lateral transhipment, which means that hospitals create shared central warehouses for most medical products (Aldrighetti *et al*., 2022).

Therefore, we propose:

> *H4. Human resources are positively related to (a) internal information integration and to (b) external information integration.*

2.7 Effects of supply chain information integration on resilience

In the wake of a crisis, like pandemic, the collaboration among supply chain partners is critical for building resilience, facilitating decision-making process and information sharing (Dubey et al., 2019; Senna et al., 2021). Under complexity, information sharing on supply chain risk reduce the impact of disruption, improve response time and build new opportunities for improving products and services (Ambulkar et al. 2015; Kamalahmadi and Parast, 2016). Collaboration and information sharing are, often, two of the most commonly cited elements of supply chain resilience and represent valuable strategies for improving resilience and in particular the organizational readiness (Ali et al., 2017; Scala and Lindsay, 2020). Building an integrated information system within healthcare organizations enable improved situational awareness of operational processes, visibility of operations, information sharing about different processes (Austin et al., 2022; Rubbio et al., 2019). In this vein, all functions can allocate resources appropriately and have clear knowledge of inventory levels and patient demands. Moreover,

recognizing the interdependence between organizational functions as well as between supply chain actors is an integration factor which is related to resilience as it quickens communication, introduce agility into process of solving problems affecting organizations and the supply chain (Poberschnigg et.al., 2020).

Therefore, we propose:

H5. Resilience is related to external (a) and internal (b) information integration.

2.8 Mediating effect of supply chain information integration

Finally, this study argues that supply chain information integration, either internal or external, mediates the impact of digital and human resources on hospital resilience. Digital resources enable healthcare organizations to develop both external information integration, impacting on information processing capability and decision-making ability, and internal information integration strengthening the synergistic benefits and improving the management of information flow. In similar manner, human resources which include both technical and specific know-how and collaborative behaviours linked to teamwork, trust and communication enable and strengthen horizontal relationship among functional departments and guarantee the accuracy of supply information sharing. Internal and external information integration based on digital and human resources allow healthcare organizations to quickly adapt and respond to interruptions improving resilience performance. Accordingly, we propose:

H6a. Internal information integration mediates the relationship between digital and human resources and hospital resilience.

H6b. External information integration mediates the relationship between digital and human resources and hospital resilience.

According to RBV, internal and external information integration represent organizational capabilities, and their development requires support from digital and human resources (Grant, 1991). Hence, we propose the research model as shown in Figure 1:

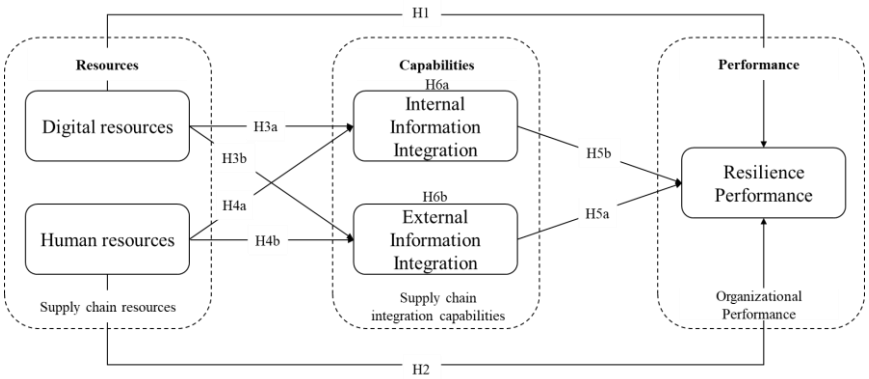

Figure 1 Proposed model

3 Research methodology

3.1 Data collection

To test the research model, we intend to conduct an online survey of an Italian sample of hospitals. We intend to focus on this country because it was one of the most affected by pandemic and we can test our model on the basis of a severe disruption as was Covid-19 pandemic. We intend to identify the potential respondents inside hospital among physicians, managers and employees. We intend to develop, pre-test and refine the survey in collaboration with experts in supply chain integration.

3.2 Measures

The survey will contain multi-item scales developed by prior management and information system research. We will assess the psychometric properties of scales, namely reliability, convergent validity, discriminant validity by conducting the following analysis using SPSS 28: composite reliability (CR), Cronbach's alpha (CA), and average variance extracted (AVE) and, finally, the confirmatory factor analysis (CFA).

4 Results

To test the research hypotheses of this study, we intend to employ PLS-SEM method which is particularly indicated when researchers include scales that previous works have validated, when the size of the sample is relatively small or,

finally, when the models are very complex (Hair et al., 2013). In PLS-SEM, the study uses the software tool SmartPLS 3.2.3 to treat information.

5 Implications and conclusion

This study intends to offer significant contributions to healthcare management researchers in advancing the current comprehension of hospital resilience. Grounded in the RBV, this study establishes a resources-capabilities-resilience framework in supply chain information integration setting. This study classifies the supply chain information integration into two dimensions: internal and external information integration. This is due to the fact that developing internal and external information integration simultaneously allows organizations to achieve efficiency and service at the same time. Internal information integration enables organizations to provide better products and services to patients through high level of communication and coordination between functions. Moreover, internal information integration also enables the absorption and application of knowledge attained through external information integration processes. In a similar vein, external information integration reduces external uncertainties and wastes increasing operational efficiency. In addition, sharing information with patients should help identify their needs improving satisfaction level. The RBV theory suggests that both tangible and intangible resources should be leveraged and bundled to build valuable capabilities and in this study digital technologies and human skill-set resources are identified as having an impact on the development of information integration capability.

Finally, this study offers insights for hospital managers and healthcare supply chain mangers in understanding the role of information integration on resilience performance. First of all, the information integration, which implies the building of integrated database so that different functions can be linked together and healthcare organizations can share information with supply chain partners, is improved by digital technologies and for this reason, healthcare managers should understand the relative importance of digital resources and should acknowledge the need to develop related technical abilities. Moreover, considering that collaborative behaviours are a prerequisite for fostering the willingness to engage in sensitive information sharing, healthcare managers should understand the relative importance of the skill-set capacity of human resources in developing

high levels of communication and coordination not only between different functions but also between partners within the supply chain.

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The Impact of Circular Economy on Innovative Startup Strategies: A Multiple Case Study

Barbara Bigliardi*

Department of Engineering and Architecture
University of Parma
Parco Area delle Scienze 181/A

Serena Filippelli

Department of Engineering and Architecture
University of Parma
Parco Area delle Scienze 181/A

Virginia Dolci

Department of Economics, Science and Law
University of the Republic of San Marino
via Consiglio dei Sessanta, 99 – Dogana (San Marino)

Benedetta Pini

Department of Engineering and Architecture
University of Parma
Parco Area delle Scienze 181/A

Alberto Petroni

Department of Engineering and Architecture
University of Parma
Parco Area delle Scienze 181/A

Leonardo Tagliente

Department of Economics, Science and Law
University of the Republic of San Marino
via Consiglio dei Sessanta, 99 – Dogana (San Marino)

* *Corresponding author*

Abstract

In 2015, member countries of the United Nations developed 17 Sustainable Development Goals (SDGs, 2019) that focus on social and environmental issues. To meet the newly introduced requirements, it is crucial to innovate the current system by combining the different dimensions of sustainability, namely social sustainability, economic sustainability, and environmental sustainability. The scientific literature identifies six macro trends, in the area of sustainability, among which the concept of Circular Economy (CE) emerges (Gaudig et al., 2021). To date, CE represents a topic of utmost interest to both the research and business worlds; indeed, CE emphasizes the conscious use of natural resources, promoting their reuse and recycling (Geissdoerfer et al., 2017). In this regard, stakeholders' attention has focused on understanding which are the main facilitators for the adoption and implementation of sustainable business strategies. Recent years have witnessed the emergence and significant growth of a new category of companies: startups. In this regard, the literature points out that this new generation of firms is, at present, the largest producer of radical innovations (Hekker et al., 2007). However, to date, research has mainly focused on the circular approaches adopted by mature firms, while contributions related to startups have been little investigated. The present study aims to focus on the relationship between startups and sustainability, with particular attention to the role of CE on innovative strategies. Indeed, startups, being unstructured business entities, have the opportunity to develop from scratch a new organizational culture that integrates the dimensions of sustainability (Nunes et al., 2022). Startups have the opportunity to build a sustainable business from the beginning by proposing a circular business model or integrating sustainability practices into business operations. The underlying hypothesis is that startups are more open to new ideas because they lack an organizational culture, consequently it is easier to establish sustainable thinking unlike established companies (Pizzi et al., 2021). To achieve this goal, the study was structured in two main phases. First, a review of existing scientific literature was conducted through the methodology of keyword analysis (Fadalla and Amani, 2015). Starting from the results obtained in the literature review phase, the main points to be investigated and then included in the questionnaire were defined. Finally, in the second phase of the study a multiple case study was conducted on a sample of 13 startups,.

Keywords – Startups, Innovation, Sustainability, Circular Economy, Innovative strategies

Paper type – Academic Research Paper

1 Introduction

Nowadays a large number of social and environmental challenges are affecting the whole world, making urgent global changes oriented towards sustainability, as it is expressly stated in the 17 Sustainable Development Goals (SDG) contained in the action plan drawn up by the UN member countries (SDG, 2019). These

efforts require a paradigm shift that implies the need to innovate the current system by considering a domain that combines the social, economic and environmental dimensions of sustainability. As such, sustainability is considered by scholars as a megatrend on a plurality of fronts, i.e., economic, political, technological, and cultural (Mittelstaedt et al., 2014). Organizations of any kind, such as companies, startups, or non-governmental organizations, as economic actors need to align themselves with the emerging sustainability paradigm in order to maintain their competitiveness in a changing marketplace and to contribute positively to the systematic change that is affecting society (Seebode et al., 2012). Within the sustainability megatrend, Gaudig et al. (2021) identifies six distinct macrotrends, among which the circular economy (CE) paradigm appears. Since the first industrial revolution, the production system has been based on the so-called linear economy, characterized by the three consecutive phases, namely take, make, and dispose (Rizos et al., 2017). The sustainable alternative to the linear production model is the circular economy, which deviates from the linear model mainly by reusing materials in new products. The concept of CE began to take hold in the middle of the last century, and nowadays it is a topic of considerable interest to the scientific community, industries and policymakers. The CE, specifically, focuses on closing material cycles, aiming at a more conscious use of natural resources, limiting their exploitation and instead promoting resource reuse and recycling (Geissdoerfer et al., 2017). In this regard, one of the major challenges that academics and policymakers are facing is to understand which are the main facilitators of the adoption of business strategies based on sustainability principles for companies, both mature and newly created. In fact, the scientific debate is increasingly tightening around the theme of startups, as they are considered important elements within the innovation system of the CE.

Several scholars (e.g. Hekkert et al., 2007) argue, in fact, that startups stimulate the production of innovation, especially radical innovation, and push other actors, such as incumbent firms, to follow their example by embracing the innovative paradigms they propose. Moreover, startups have the advantage of overcoming one of the main problems that limits the implementation of sustainable practices in already mature businesses: being nascent firms, they are endowed with high flexibility that allows them to adapt to unconventional strategic choices, such as the adoption of principles proper to the CE (Pizzi et al., 2021). However, to date, research has mostly focused on circular approaches adopted by incumbent firms,

while the contributions of startups are still under investigated. For this reason, the present study focuses on the relationship between startups and sustainability, specifically it investigates the role of CE on the innovative strategies of 13 startups. The contributions of this work to existing scientific knowledge are several. Firstly, from a general point of view, this study contributes to the literature on entrepreneurial ecosystems. Secondly, this work underlines the relationships that exist between startups and sustainability, promoting the development of a strategic tool for entrepreneurs. The article is structured as follows: in Section 2, the methodology adopted to conduct the study is presented. Section 3 presents the results of the literature review through keywords analysis, while in Section 4 the results of the multiple case study are shown. Finally, Section 5 provides conclusions, limitations and future research directions.

2 Methodology

The research framework adopted in the present study consists of two main steps. First, a literature review was conducted using the keywords analysis methodology proposed by Fadlalla and Amani (2015). The second step consists of a multiple case study based on the results that emerged from the literature review.

2.1 First phase: keywords analysis

The research process started with a review of the literature on the subject conducted through the keywords analysis methodology proposed by Fadlalla and Amani (2015). This analysis allowed us to classify the main issues concerning the relationship between startups and sustainability based on the keywords indicated by the authors of the articles in the sample. Specifically, the keywords were categorized based on two parameters, frequency, and persistence, which indicate, respectively, the number of papers in which the word appeared as a keyword and the number of years in which it was used. The result was the classification of the keywords into four broad categories, identified by crossing the dimensions just mentioned and labelled as follows: trendy, emerging/phantom, core and intermittent. The keywords in the trendy quadrant refer to the issues that are of most interest to the scientific community, while those in the core quadrant help to understand the theoretical basis of the topic studied. The emerging/phantom

quadrant, on the other hand, contains the words that appear with low frequency and persistence, while the intermittent ones refer to topics treated with discontinuity. To conduct this analysis, the following query was entered into the Scopus database: TITLE-ABS-KEY ("startup*") AND TITLE-ABS-KEY (innovation) AND TITLE-ABS-KEY (sustainability), which returned 140 results (as of December 2022). Secondly, articles without authors' keywords or articles on topics not related to startups and sustainability were discarded, resulting in a final sample of 116 papers. Finally, in order to avoid distortions in the calculation of frequency and persistence, the keywords of the sample were standardized by making a series of corrections.

2.2 Second phase: multiple case study

2.1.1 Questionnaire development

The result of the keyword analysis made it possible to define the main points to be investigated through the questionnaire analysis. In particular, the topics that appeared in the trendy and core quadrants were investigated in depth, as they were indicative of an interest on the part of the scientific community. The questionnaire used in this second phase consisted of 4 sections, whose questions were formulated in such a way as to present a list of response options. The first section "Startup profiling" aims to collect general information about the startup (e.g., name, year of foundation, type of startup, turnover). The second section, "Attitudes of startups towards sustainability", aims to assess the degree of interest in sustainability. In detail, this section contained questions to investigate startups' desires for local/national/international programmes/projects supporting sustainability or how startups participated in sustainability initiatives. Section 3, "Adoption of circularity strategies", aims to investigate whether and how the responding startups adopt one or more of the 9 circularity strategies, i.e., reject, rethink, reduce, reuse, repair, refurbish, remanufacture, reuse, recycle and recover. Finally, the fourth section, "Circular Business Model", aims to investigate whether the above-mentioned startups adopt circular business models.

3 Keywords analysis results

Figure 1 summarizes the results from the keywords analysis. The keywords were sorted into the four quadrants by combining the two dimensions of frequency

and persistence. In particular, the two average values of frequency (ADC) and persistence (APC) have been identified, obtained by performing the arithmetic mean of the frequency and persistence values of all the keywords except those with a value equal to 1 and those used as search keys in the string on Scopus (i.e., startup*, innovation and sustainability,). Frequency or persistence values lower than the average value return low levels of the two dimensions, vice versa high levels. For the purposes of this study, it was considered appropriate to focus the discussion on the topics that appear in the trendy and core quadrants. In this regard, two main aspects of research have been identified: startups characterized by sustainable business models (SBM) and strategic collaborations.

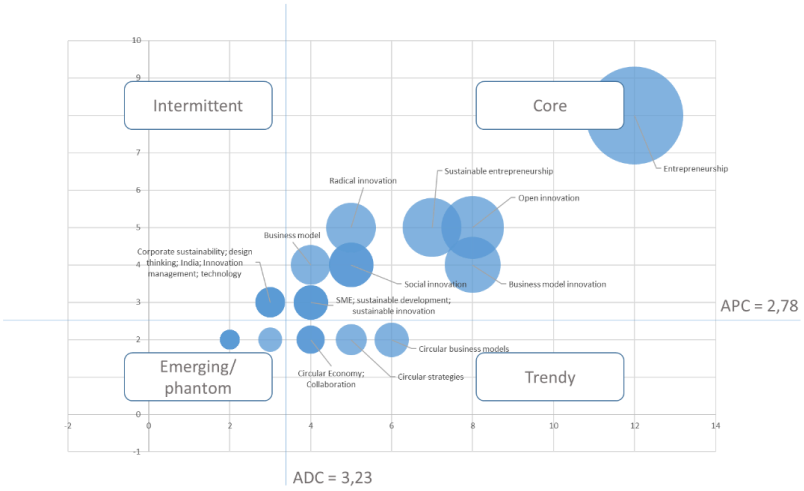

Figure 1 Keywords distribution across quadrants

3.1 Startups' SBMs

Business models (BMs) indicate a firm's competitive strategy, how the firm produces its product or offers its service in the marketplace, price, production costs, how it differentiates its value chain from that of other firms, and how it collaborates with other firms. BMs are seen as a key factor in the transition from a linear economy based on end-of-life product waste, to a CE. BM innovation, in fact, offers a potential approach (Henry et al., 2020) to achieve the required change by rethinking the purpose of the enterprise and the logic of value creation (Pieroni et al., 2019). With a view to leading the system to circularity, a transition from a linear economy to a CE, BM innovation is required for the specific purpose

of incorporating CE elements into the current BM. At a general level, we speak of SBM, i.e., BMs that have integrated the dimension of sustainability within the organization. Consequently, it is correct to speak of SBM innovation, which differs from the more traditional BM innovation due to the incorporation of the three components of sustainability, namely environmental, social, and economic sustainability (Boken et al., 2018). Businesses oriented to shift toward the sustainability paradigm must necessarily develop a "sustainable mindset" by integrating business performance measurement with social and environmental, as well as economic, indicators (Stubbs et al., 2008). Moreover, when talking about SBM, it is important to emphasize the concept of value, which includes costs and benefits not only for the company and its customers, but also for the environment and society (Bigliardi and Filippelli, 2021). Since numerous studies recognize the CE as a driver to achieve corporate sustainability goals, the concept of circular BM has recently become popular (e.g., Bardford et al., 2022). Linder and Williander (2017, p.2) formulated one of the first definitions of circular BM by stating that it is "*a business model in which the conceptual logic for value creation is based on utilizing the economic value retained in products after use in the production of new offerings*". More specifically, the literature has identified four ways in which a BM becomes from sustainable to circular, namely through recycling, extension, intensification, and dematerialization of materials and energy in order to reduce the amount of input (Geissdoerfer et al., 2020). Considering circular BMs, to date the literature has focused mainly on the analysis of BMs of incumbent companies, i.e. companies already established in the market, in order to incorporate the dimension of circularity in them (Brendzel-Skowera, 2021). Specifically, innovating the BM to embrace the CE paradigm can be done by implementing different strategies. A company can, in fact, design a totally new BM to replace the existing one, or it can operate a transformation of the current BM or, finally, implement a diversification strategy by acquiring an additional BM to be placed alongside the current one (Bigliardi and Filippelli, 2021). Salvador et al. (2020) highlighted how the size of a firm influences the design and subsequent implementation of CE practices. In fact, according to the authors, firm size can be a barrier to the adoption of circular strategies because a large, market-mature firm has little flexibility and finds it more difficult to innovate its business model. Moving away from "business as usual" is necessary to overcome the current trends in resource use caused by a linear socio-economic system, but the rigidity of structured firms does not always make this transition easy. Conversely, smaller firms such as

startups, being less entrenched in their BMs, are often a source of innovation and can create disruptive changes in their BMs because of their greater flexibility. When comparing the strategies required to implement circular BMs, the results indicate that circular startups tend to embrace CE activities at a higher level than incumbent firms (Veleva et al., 2017).

3.2 Strategic collaboration

Although startups have far greater inventive capacity than well-established companies, whose business is well established, they often have major problems with innovation, finding rigidity in the commercialization of the products resulting from it. One of the main problems that startups have to face is the lack of resources of any kind: financial, human and physical, for this reason it is difficult to bring to market the technological or product innovations made (Khilji et al., 2006). As far as circular strategies are concerned, the adoption of circular practices by innovative startups is subject to the same criticalities, since it is necessary to have resources, infrastructures and knowledge that only in rare cases already belong to the startup, while they are much more likely to be held by a plurality of actors outside the organization. It follows that one way to overcome this limitation is to undertake strategic collaborations with different partners that guarantee the contribution of those complementary capabilities that the startup lacks. In this regard, it is necessary to create a network of relationships that facilitate the implementation of CE practices in the company's business, as well as the marketing of a product made by adopting such practices (Chesbrough, 2003). This inevitably implies an exchange of knowledge and skills between the startup itself and the surrounding environment, made up of the different actors that the startup needs. This tendency to engage in strategic collaborations refers to the paradigm of open innovation (OI), which results as a core keyword. The concept of OI was introduced by Chesbrough (2003) in 2003 to emphasize how the combination of knowledge from inside and outside the organization fosters the production of innovation. Applying the concept of OI to startups, it is possible to frame different types of actors that intervene in the value creation processes, such as incubators, established companies, VC firms, companies operating at different levels of the value chain, research institutions or other startups, with whom it is possible to share resources (Spender et al., 2017; Badiale et al., 2022).

4 Analysis and results from the multiple case studies

4.1 Sample overview

The startups included in this research are all limited liability companies that operate in different sectors. They all have in common the presence of an innovative idea of product, service, process, technology, organization or business model. An overview of the startups' profile, together with the indication of the interviewees, is proposed in Table 1. For privacy issue we replaced real startups' names with letters.

Table 1 Sample presentation

Startup	Year of establishment	Sector	Interviewees	Number of employees	Annual turnover	Average employees age
A	2021	Packaging	company owner and founder	0	0 – 50.000€	46-50
B	2021	IT consulting	company owner	1-3	100.000 – 500.000€	>50
C	2018	IT consulting	company owner	4-10	500.000-2.000.000€	46-50
D	2020	Food	company owner	1-3	100.000 – 500.000€	20-25
E	2019	Software production	company owner	1-3	50.000-100.000€	41-45
F	2021	Software production	company owner	1-3	0 – 50.000€	>50
G	2021	Biotechnology	founding member	0	0 – 50.000€	46-50
H	2021	Manufacturing	company owner and founder	0	0 – 50.000€	36-40
I	2020	Software production	company owner and founder	1-3	100.000 – 500.000€	41-45
L	2016	Software production	company owner and founder	4-10	100.000 – 500.000€	46-50
M	2015	Manufacturing	administrative officer	4-10	500.000-2.000.000€	>50
N	2020	Marketing consulting	company owner	1-3	100.000 – 500.000€	26-30
O	2015	Manufacturing	employee	>10	> 5.000.000€	>50

4.2 Startup and sustainability with respect to startup size

The exhibition of the survey results focuses on two main directions, in accordance with keywords analysis results, namely the tendency of startups to address the issue of sustainability and the strategic collaborations they engage in. Both issues were studied in relation to the size of the startups investigated. Specifically, although there is no official classification of startups based on their size, for the purpose of this study three categories of startups were identified based on turnover, as shown in Table 2.

Table 2 Startup classification with respect to size

Turnover	Startup category	N. of startups in the sample	Startup
< 50.000€	Micro	4	A,F,G,H
50.000 – 500.000€	Medium	6	B, D, E, I, L, N
>500.000€	Large	3	C, M, O

As previously discussed, sustainability is declined in the three dimensions of social, economic and environmental sustainability. Thus, it was at first found which dimension or dimensions of sustainability the startups investigated are pursuing. Respondents were provided with a definition of the three forms of sustainability so that their response could not lead to misunderstanding. Specifically, by economic sustainability we intend a use of resources in such a way that real incomes are not compromised in the future, allowing subsequent generations equitable access to resources (Markandya and Pearce, 1988). The definition of social sustainability is given by Black (2004, p.34): "*the social dimension of sustainability has to do with the extent to which social values, social identities, social relationships and social institutions are capable of being maintained into the future*." Finally, environmental sustainability refers to the protection of the ecosystem and renewal of natural resources focusing on different types of strategies: reduction of extraction of natural resources, reduction of production of pollutants, reduction of physical degradation of nature (OECD, 2001). Of the 13 startups under investigation, only one stated that it did not pursue any of the three forms of sustainability, while the rest were divided into 3 startups that address the social dimension jointly with the environmental dimension and 9 that address only the environmental dimension. Next, it was asked what ways startups adopt to pursue sustainability goals. It was found that

micro startups favor joining local, regional or national sponsored sustainability support programs (i.e., startups A, F), and using SBM to integrate more circular practices (i.e., startups A, F, G, H). In contrast, larger startups prefer an approach that does not involve a radical revolution of the existing BM (i.e., B, D, O). One possible explanation for this phenomenon is related to the possibility of likening medium and large startups to incumbent companies, which are more financially robust and have a more established market presence than micro startups. Looking at the graph in Figure 2 we notice that large startups are the oldest, founded between 2015 and 2018. Medium startups, on the other hand, were founded between 2016 and 2020, with one exception in 2021. Finally, all micro startups are newly founded, that is, in 2021. The literature concerning Circular BMs (e.g., Bigliardi and Filippelli, 2021; Geissdoerfer et al., 2020) points out that incumbent firms, which are well established in the market, rarely resort to disrupting their current business model to make it circular because of limited organizational flexibility. In contrast, smaller firms such as startups, being very young, do not have a layered structure, thus they can easily change their business model depending on the desired sustainability goals.

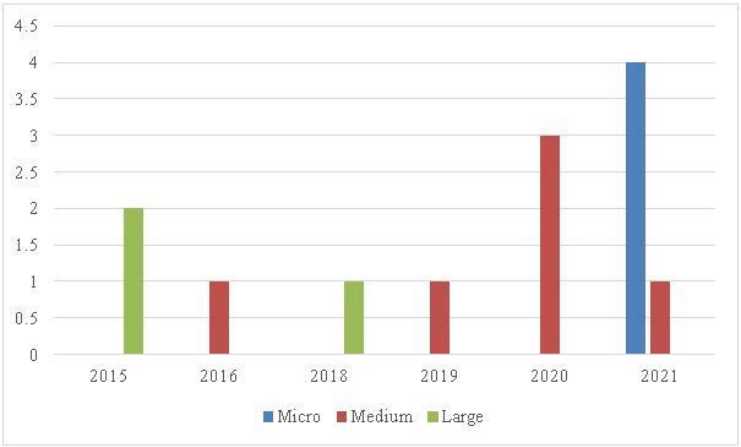

Figure 2 Year of establishment of the startups included in the sample

As for the motivation of startups to embrace sustainability, it was found that the majority of the micro startups (i.e., F, G, H) show reasons related to corporate vision and mission. That is, at the time of creation the founders took care to include sustainable initiatives and practices. In only one case (i.e., A) the motivation lies in corporate social responsibility, i.e., the company while not

obligated decided to adopt processes or use products that would enhance corporate sustainability. Considering, on the other hand, larger startups, in only one case (i.e., C) the motivation is embedded in the corporate vision. In most cases (i.e., B, D, L, M, O), in fact, the company resorted to sustainability practices to fulfil regulatory obligations that required it to meet specific environmental regulations.

Looking specifically at the environmental dimension, the main circular objectives pursued were identified. In this regard, as shown in Figure 3, there is uniformity in the objectives across the three sizes, with the exception of life cycle assessment (pursued by 3 micro startups, i.e. A, F, H) and greenhouse gas reduction (pursued by only one large startup, i.e. C). Specifically, life cycle assessment (LCA) helps to understand the impact generated toward the environment by products, services, economic systems, or production chains. It implies that this practice is implemented by firms producing tangible products, which would explain why few startups in the sample selected this objective: most do not make physical products but operate in the field of IT services.

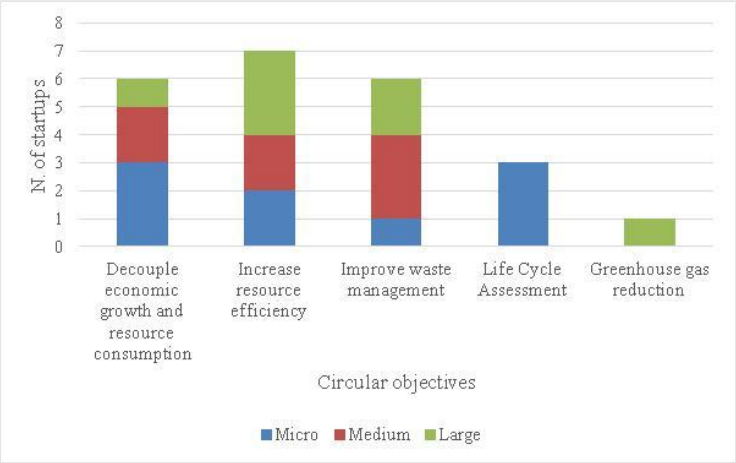

Figure 3 Startups' circular objectives

Another interesting theme concerns the sample startups' adoption of circular strategies. Specifically, the respondents were asked to identify which of the circular strategies identified by Potting et al. (2017) (i.e., Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover) have been adopted.

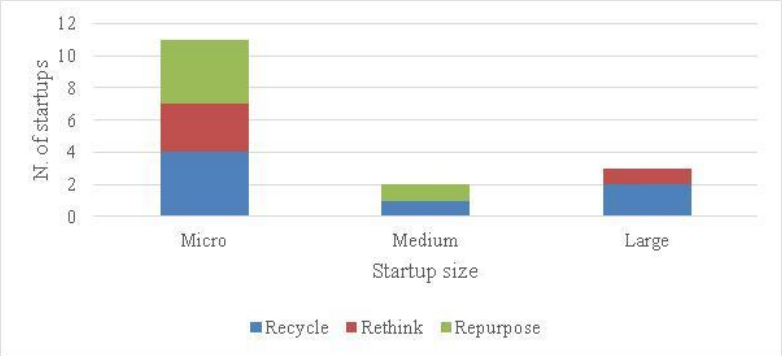

Figure 4 Startups' circular strategies

As is shown in Figure 4, there are three strategies adopted by the startups in the sample, namely recycle, repurpose, and rethink. Notably, there is a marked difference between micro and medium-large startups. The latter appear disinclined to implement circular strategies and, in most cases (i.e., D, M, O), focus only on recycling, in accordance with the goal of improving waste management. Micro startups, on the other hand, show a propensity to adopt strategies that can lead the business system to greater circularity. This goes hand in hand with the tendency, typical of the micro startups in the sample, to innovate the business model to include elements of circularity. It is worth specifying that in the sample considered, rethinking practices concern the possibility of creating products sharable among users, repurposing practices aim to maximize the value of resources through product reengineering, and recycling practices concern the possibility of recovering by-products of production systems and reducing the amount of waste. The summary of case study results in relation to the sustainability issues can be seen in Figure 5.

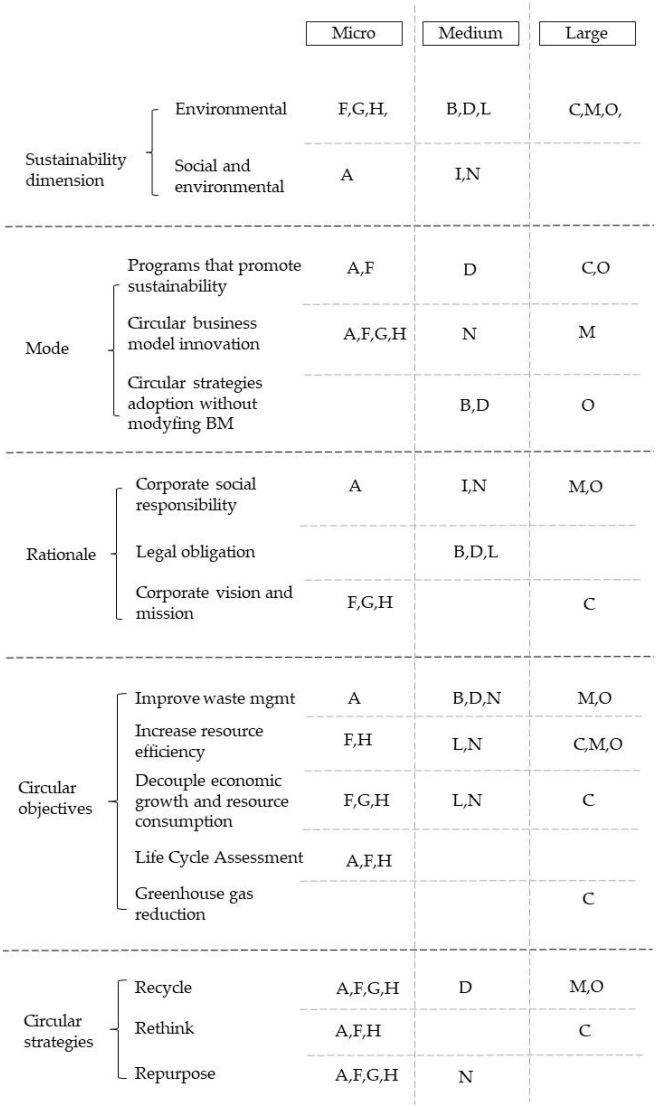

Figure 5 Summary of case study results with respect to sustainability issue

Last, the issue of collaboration regarding the adoption of sustainable practices was studied. All micro startups in the sample resorted only to using internal company resources to develop circular-oriented innovations, while all large startups resorted only to collaboration with external partners (see Figure 6).

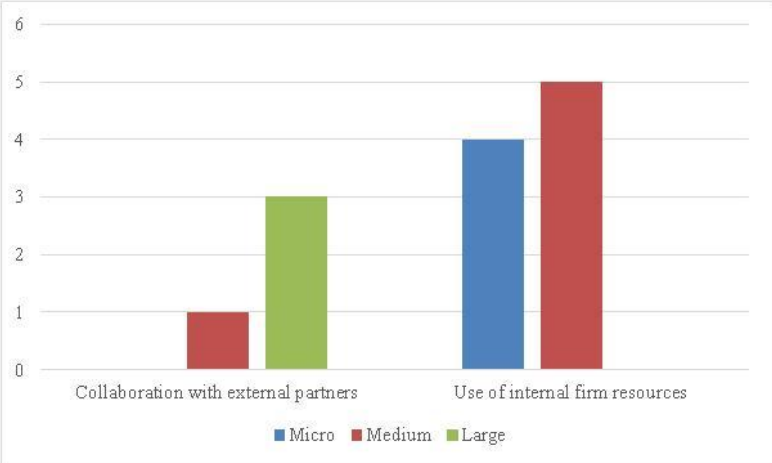

Figure 6 Startups' strategic collaborations

In this regard, it can be inferred that larger startups are more likely to resort to the OI paradigm, theorized by Chesbrough in 2003, according to which the use of external ideas, knowledge and skills in conjunction with internal ones fosters the production of innovation within the company. Accordingly, this is done through strategic collaborations with players outside the company, e.g., customers, suppliers, universities, research centers, competitors, etc. Looking at the large startups, Figure 7 summarizes the external collaborations conducted and their duration over time.

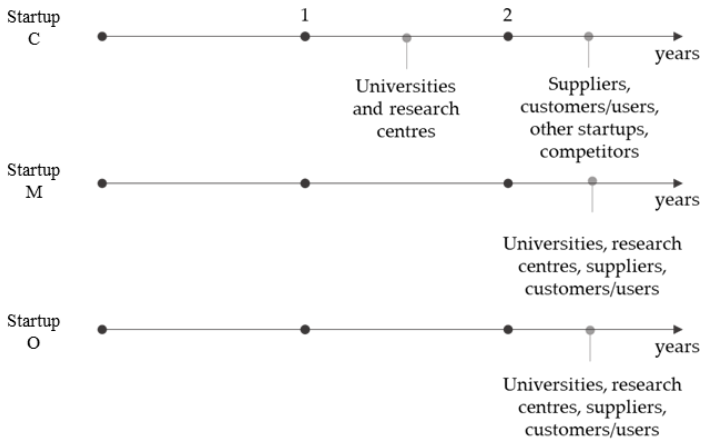

Figure 7 Large startups' collaboration partners and duration

In terms of the collaborations objectives, all three startups agree with the need to acquire missing knowledge, speed up growth and subsequent achievement of the breakeven point, and gain access to new markets.

5 Conclusions

Over the past decade, the number of startups has grown significantly, contributing positively to regional and national development by increasing productivity, encouraging innovation and bringing new products or services to the market. Since the year 2015 when the United Nations drew up a list of SDGs to be achieved by 2030, the scientific literature has increasingly focused on a specific area of study concerning startups, namely the promotion of sustainability in startup businesses. The reason lies in the fact that startups, being yet unstructured business entities, have the opportunity to develop a new organisational culture integrating sustainability dimensions from scratch. Incumbent companies, having a more rigid structure, experience greater difficulty in pursuing environmental, economic and social sustainability objectives that require profound changes to the corporate organisational structure. Startups can realise a sustainable business from the very beginning, by proposing a circular business model, or to integrate sustainability practices into the company's operations. The underlying hypothesis is the fact that new business ventures are more open to new ideas because they lack an organisational culture, consequently it is easier to establish sustainable thinking unlike well-established companies.

In this regard, our paper aims to understand the approach towards sustainability of a sample of startups that are not specifically sustainable, i.e. that do not meet the definition of sustainable startups. A multiple case study was carried out on 13 startups following a survey. The issues investigated were identified through a literature study carried out by means of a keyword analysis. The approach proposed by Fadlalla and Amani (2015) was adopted and allowed the identification of hot research themes on the topic of sustainability in startups. Specifically, SBMs and strategic collaborations emerged as the topics of most interest in the literature. In order to carry out the multiple case study, the startups were divided on the basis of their size into micro, medium and large. The micro startups are characterised by varied sustainability goals and massively adopt circularity strategies such as recycle, rethink, and repurpose. The adoption of

sustainable practices is mainly through BM innovation, and in only two cases through specific sustainability promotion programmes. The motivation for adopting a sustainable approach is inherent in a corporate vision that incorporates sustainable thinking. As far as medium-sized startups are concerned, they have circular goals related to more efficient waste management, more efficient use of resources and decoupling of economic growth and resource consumption. The adoption of sustainable practices occurs in different ways, without one prevailing over the others, whether through BM innovation, sustainability promotion programmes, or the adoption of strategies that do not involve a change in the business model. The main reasons are related to legal obligations and corporate social responsibility. Finally, large startups have varied circular objectives, as in the case of micro startups, and the main strategies adopted involve recycling and rethinking. The rationale is linked to corporate social responsibility and corporate vision, while the methods are as varied as in the case of medium-sized startups.

Considering the results obtained, future research can be envisaged to complete the picture found. Firstly, since the sample consists of only 13 startups, it would be appropriate to carry out a further study considering a larger number of business entities to accompany the qualitative analyses presented in this paper with quantitative analyses. Furthermore, the sample investigated does not belong to a specific industry, so it would be interesting to repeat the study by selecting an industry, or by comparing several industries to assess any differences. Finally, the concept of strategic collaborations emerged from the literature review, consequently, a further advancement of the research could include the analysis of the collaborations implemented by startups in order to adopt a more sustainable approach.

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Self-Financing in Growth Strategies of Italian SMEs: A Case Study

Maria Teresa Bianchi

Department of Law and Economics of Production Activities
La Sapienza University, Rome, Italy
Via del Castro Laurenziano 9, Rome

Francesco Antonio Rusciani*

Department of Law and Economics of Production Activities
La Sapienza University, Rome, Italy
Via del Castro Laurenziano 9, Rome

* *Corresponding author*

Abstract

In international markets, territoriality increasingly represents a decisive success factor for companies, particularly Italian ones, which, thanks to their intellectual capital, manage to be competitive in the era of globalisation in which we find ourselves, despite strong competition at world level. In fact, with particular reference to industrial companies, Italy has managed to make the concept of 'Made in Italy' perceived as a guarantee of quality and luxury throughout the world, creating a brand under which all Italian companies are recognised.
The reputation of the Italian manufacturing company is, in fact, known worldwide and is a hallmark of creativity and quality.
This paper aims to investigate the propensity of Italian SMEs to self-finance and invest in research, development, and innovation.
The research is conducted by analysing the findings of a company case study. The results for the three-year period 2019-2021 of a medium-sized Italian company belonging to the manufacturing sector were analysed to examine how a medium-sized family business can implement a growth project through the predominant use of internal financial resources.
The results show how, through self-financing, the company was able to increase its value and market share, especially abroad. This was done by investing heavily in innovation and research, despite the economic crisis resulting from the Covid-19 pandemic.

Keywords – Made in Italy, Self-financing, SMEs, Intellectual capital.

Paper type – Practical Paper

1 Introduction

The purpose of this paper is to analyse the importance of internal sources of finance within the growth strategies of Italian small and medium-sized enterprises and how internal sources have been used in investments aimed at strengthening the value of 'Made in Italy'.

It is, therefore, a company strategy: to focus on made in Italy and, at the same time, a strategic choice of a financial nature: to focus on internal sources.

The 'made in Italy' label is recognised worldwide as a feature that gives an intrinsic value to any product on which this wording is indicated.

Italian companies, from the few large to medium and small, with particular reference to industrial and manufacturing companies, have succeeded in creating a globally recognised perception of luxury and product quality.

The management of small and medium-sized Italian companies, which are often family-run, use the history of their family and territory to create a bond with the consumer through the transmission of cultural values, responsibility, and authenticity by emphasising the concept of 'Made in Italy' (Del Baldo, 2012). The creation of these bonds makes 'Made in Italy' a true national brand, representing all products made in Italy and to which it gives an added value, perceived as such throughout the world. In turn, the application of this brand gives the product an added value, other things being equal, compared to the same good produced in other countries of the world (Cappelli, D'ascenzo et al., 2017).

It is necessary to pay attention to the intangible components that have allowed Italian companies to penetrate foreign markets and achieve very high competitiveness at the top end of the market, exploiting market differentiation and targeting strategies (Galeotti and Garzella 2013). Indeed, Italian products are associated abroad with the idea of luxury and 'premium' products, thanks to the Italian style that sets them apart. In the collective imagination, Italy is recognised for its millennia of history, culture, and traditions, which are reflected in the style and quality of products made in Italy. In fact, the manufacturing sector is one of the driving forces of the Italian economy, with an increase in production since the crisis of 2008 until 2019, the last year taken into account due to the economic crisis, resulting from the COVID-19 pandemic, which exploded in 2020. However, by 2021 Italian manufacturing had already regained its pre-pandemic levels (Confindustria Report for 2021), performing better than Germany and France, even though these two countries had experienced a smaller drop in production at

critical times in 2020. This testifies to the fact that the manufacturing sector is a driving force for t h e Italian economy, even thanks to exports, which returned to an even higher level in 2021 than in 2019.

The manufacturing sector is mainly composed of small and micro enterprises that employ more than half of the workforce in the sector. Regarding this industrial sector in particular, Italy has a strongly positive image abroad, built up over the years and stemming from the history and culture, design, creativity, tourism, and lifestyle that only belong to Italy (Cappelli, D' Ascenzo et al., 2017).

In fact, also thanks to the phenomenon of globalisation, Italy and its companies have succeeded in establishing themselves as exporters of premium goods, recognised as such, and thus generating in consumers in foreign countries such as the United States, China, Russia, and the United Arab Emirates a very high willingness to pay for goods bearing the 'Made in Italy' label.

The status of premium products is universally recognised due to the relationship that companies have with the territory and the resulting value they create for stakeholders (Festa et al, 2020; Del Baldo, 2012).

This universally recognised value is also, and above all, created by small and medium-sized manufacturing companies, often family-run, which invest heavily in the region and in innovation to improve production standards.

The aim of this paper is to analyse how these investments generate value, especially for foreign consumers, and with which sources of financing the needs generated by these investments are covered.

2 Analysis of the literature and regulatory context

It is demonstrated in the literature how the strength of Italian companies, and therefore of 'Made in Italy' in general, is based on entrepreneurial skills, business networks and intellectual capital (Schiuma and Lerro, 2008; Demartini and Del Baldo, 2015). In fact, 'Made in Italy' products are distinguished by characteristics that are both material, such as raw materials, production techniques, quality, and precision in the assembly of the products; and immaterial, such as the context and working methods with which they are made, the link with the territory of origin and the history behind the producing companies (Festa et al., 2020).

The affirmation of 'Made in Italy' as a premium brand is certainly due to the ability of the large successful companies operating in the food sector, such as

Ferrero, Barilla, Lavazza; fashion, from Ferragamo to Gucci; and automotive, such as Ferrari, Lamborghini, and Maserati.

However, the true essence of 'Made in Italy', representing the craftsmanship of the products, the relationship with the territory and the Italian lifestyle that is constantly sought after abroad is perfectly expressed by small and medium-sized Italian companies. This type of company, especially when exporting its production, relies on the craftsmanship and quality that comes from Italian origin. In fact, most Italian companies do not operate in sectors where economies of scale or scientific excellence are critical success factors. Often, as in the case study at hand, the pillars of success are production technology, access to certain exclusive raw materials, or the brand. This happens more in sectors where the success of Italian SMEs abroad is very strong, such as food, fashion, and furniture, the so-called '3Fs'.

The territory has become an instrument of competition, acting as a repository of localised knowledge, one thinks of certain areas related to the production of leather goods or cars, and consequently becoming a guarantee of product quality.

In fact, the reputation of 'Made in Italy' is linked not only to human factors, such as design and creativity, but also to territorial factors, e.g., the leather goods industry in Tuscany, the eyewear industry in Veneto or the automotive industry in Emilia-Romagna.

This added value can be found in the intellectual capital of Italian companies that have been able to build and enhance a very positive image thanks to their relationships with the territory, their employees, and the individual knowledge of individuals, which is a key element for the success of SMEs (Paoloni et al., 2020; Camuffo et al., 2007)

The surplus value recognised for goods produced in Italy has led over the years to continuous and repeated attempts at counterfeiting in many sectors, from food to fashion and consumer goods. In fact, global trade in trademark-infringing products in Italy exceeds €24.3 billion in the pre- pandemic period (2018, OECD data). Imports of counterfeit products into Italy have also reached a significant level, amounting to €9 billion, representing over 2% of total imports into Italy.

Relocation strategies, implemented by companies in order to lower labour costs and tax burdens, have also meant that more and more parts of the production process are carried out in countries other than Italy, where only the last, or some phases of the production process take place.

Empirical proof of the above is the phenomenon of 'Italian sounding', i.e., the tendency to recall distinctive Italian elements, such as the colours of the flag, names, places, or typical expressions that suggest a provenance with the country but have no connection with Italy.

The Italian regulatory framework on the protection of origin marking is confusing and unorganised. The supranational source regulating indications of origin is the Madrid Agreement of 1981, which prohibits the affixing of false or misleading indications of origin on products. The 2004 Finance Act made it an offence to import, export and market products bearing false or misleading indications of source or origin. Under the law, it is also an offence to use signs that may lead the consumer to believe that the product has Italian origin. However, this risk is only averted in Italy, as the ban on the use of such distinctive product signs only applies on the Italian market and to a certain extent on the European market, generating the aforementioned phenomenon of 'Italian sounding'.

The reference legislation on the origin of products is identified at European level in the European Union Customs Code, established by Regulation (EU) No 952/2013 of the European Parliament and of the Council of 9 October 2013.

The regulations identify two types of origin: preferential and non-preferential. The first, preferential origin, has very stringent requirements since its recognition confers customs benefits on the products.

Non-preferential origin, on the other hand, is recognised when products are wholly manufactured in one country or, if two or more countries are involved in the manufacture of a product, origin is obtained where t h e goods have undergone their last, substantial, economically justified working or processing in a company specially equipped for that purpose, resulting in the manufacture of a new product or representing a major stage of manufacture.

In fact, there is a tension of opposing interests in this area: on the one hand, large companies that adopt strategies to delocalise production, demand more flexibility on the use of the label 'Made in Italy'; on the other hand, small and micro artisan companies, through trade associations, have always demanded a stricter discipline to enhance the craftsmanship of their products, their link with the territory and reduce the number of goods offered on the market that can have the label 'Made in Italy' (Temperini et al., 2016).

As mentioned above, the economic crisis resulting from the Covid-19 pandemic was a major shock for Italian companies, especially the manufacturing

sector, in 2020. However, the recovery was excellent, returning production to pre-crisis levels in 2022.

This was made possible not only by the business and household assistance policies adopted by the government, but also by the ability of entrepreneurs to react to the crisis and reinvest in the business, sometimes sacrificing their own remuneration. In particular, small and medium-sized enterprises, which make up the Italian entrepreneurial fabric, were able to cope with the sudden shock that interrupted the economic and financial cycle, generating liquidity crises. Especially the most indebted companies, although in financial equilibrium, found it more difficult to find additional resources and guarantees for new financing. In fact, the issue of the undercapitalisation of Italian companies, especially small and medium-sized, often family-run businesses, and the massive recourse to bank credit has characterised the Italian economic-financial context for years (source: Bank of Italy).

The topic of sources of financing for SMEs in Italy has been extensively discussed in the doctrine (Block et al., 2018; Irwin et al. 2010; Paoloni et al. 2019; Tutino and Paoloni, 2012).

In general, companies are born with a financial need: their economic/financial cycle sees costs placed before revenues, and in particular costs attributable to investments in durable goods necessary to start production (Bianchi M.T., 2022; Bianchi C., 1998; Capaldo, 2013).

The sources of funding identified in doctrine are generally:

- Equity.
- Debt.
- Hybrid financing, such as equity loans or subordinated loans.
- Self-financing.

Self-financing is a form of covering needs, which, however, does not entail an injection of new liquidity into the company. In fact, it only involves the retention of monetary resources generated by operations (Bianchi, 2022).

Self-financing strategies are often linked to the product life cycle. In fact, in the early stages of the cycle companies tend not to distribute earnings in order to reinvest them in product development, in the maturity phase the dividend policy will certainly be freer (Yusra et al. 2019).

In addition to the above, a rising interest rate scenario is characterising the market and increasing the cost of money for households and businesses.

In light of this, it is evident how the use of internal financing sources, typically found in retained earnings, becomes vital for the economic and financial equilibrium of the company.

Self-financing is generated by the renunciation of the distribution of earnings, or part of them, by the shareholders, to which must be added all costs that do not have a monetary manifestation (depreciation, amortisation, provisions, and write-downs net of the use of funds) (Capaldo, 2013). Self-financing is, in itself, an index of company health as it indicates the propensity of shareholders to capitalise the company and strengthen its capital structure by reinvesting their profit. Indeed, for years the regulatory system has sought through measures such as the 'ACE' (Aid to Economic Growth) and, following the Covid-19 pandemic, the 'Super ACE' for the year 2021, to strengthen the capital structure of companies, especially small and medium-sized ones. Therefore, waiving shareholders' remuneration in order to ensure business continuity and enable the company to make further investments is also socially responsible behaviour from an ethical point of view.

It is evident that from an accounting point of view, with particular reference to the portion of undistributed earnings, self-financing represents an internal source of financing within the company and is comparable to equity capital, therefore, it needs to be adequately remunerated. In fact, the uses must all be capital deployments that in the future will have to generate surplus income for the company, creating value for the stakeholders and also for the shareholders.

It is, however, clear that companies cannot practise overly restrictive dividend policies, especially those with widespread share ownership, as they would discourage investors and potential investors from subscribing to new capital. Therefore, it is necessary to balance these two shareholder interests, that of corporate growth and that of immediate equity returns (Bianchi, 2022).

3 Methodology / Value

The research is conducted by means of a qualitative methodology: the direct analysis of a single case study aimed at analysing the value creation and internationalisation strategy of an Italian SME through the observation and study of its business model and the structure of its capital sources.

The structure of funding sources was studied, with particular reference to the relationship between external and internal sources.

Starting from the information contained in the financial statements prepared in ordinary form, pursuant to Articles 2423 et seq. of the Civil Code, consisting of:

- Balance Sheet.
- Profit and Loss Account.
- Cash flow statement.
- Notes to the accounts.
- Management Report.

An analysis of the corporate strategies implemented in the three-year period 2019 - 2021 was carried out by analysing the quantitative and qualitative relationship between sources and uses of capital.

The company, which voluntarily provided the data for the study, is a medium-sized family business. It was founded in 1992 in the province of Latina, in lower Lazio, and in just a few years established itself as a major player in the national market for composite sinks. In the twenty years since its foundation, it has become a leader in the Italian market for composite sinks, competing with international giants such as Franke, Corian, and Shock. Since 2008, the group has been expanding in size by attacking new markets, first in China with the Shanghai branch, and then expanding in Europe, opening branches in the UK, Poland and Germany.

The company has in fact decided in 2020 to also launch the production of a new bathroom furniture product line with a structured investment project that aims to double its production capacity by 2024.

Personnel and Fixed Assets	**2019**	**2020**	**2021**
Personnel costs	4.948.704	5.042.479	7.314.102
number of employees	142	152	202
Fixed Assets	12.862.301	26.073.804	28.252.694

In fact, as can be seen from the graph, personnel expenses increased by 48 % (employment increased from 142 to 202 between 2019 and 2021) consistent with the increase in fixed assets, which was 120 % from 2019 to 2021.

In 2021, the company made new investments totalling EUR 3.7 million, of which about EUR 780.000 was in research and development and about EUR 490.000 in other intangible assets.

Net Financial Position (global)	2019	2020	2021
Cash and equivalents	(43.590)	(2.495.222)	(3.247.901)
Financial debt - bank (short term)	2.815.538	590.332	2.316.789
Other financial debt (short term)	9.652	4.592	154.031
Short-term share of financing	1.031.609	397.228	952.427
Financial credit (short term)	(285.010)	(93.652)	
NFP (short term)	**3.528.199**	**(1.596.722)**	**175.346**
Other debt (long term)			364.375
Long-term share of financing	5.259.106	8.177.377	7.270.400
NFP (long term)	**5.259.106**	**8.177.377**	**7.634.775**
NFP	**8.787.305**	**6.580.655**	**7.810.121**

The company's financial position shows an excellent ability to create value for shareholders, in fact, the ROE (considering net income, post-tax) is 38% in 2019, 15% in 2020 and 18% in 2021. The sharp decrease in return on equity is only due to the increase in net assets from 2019 to 2020 due to the increase in revaluation reserves made as a result of special laws to deal with the Covid-19 pandemic crisis. In fact, net earnings grew exponentially from 1.02 million in 2019 to 3.87 million in 2021.

Capital sources and uses	2019	2020	2021
External sources (Debt)	9.115.905	9.169.529	11.058.022
Internal sources (Equity)	7.436.550	22.427.765	25.804.480
Leverage (D/E)	01,2258	00,4088	00,4285

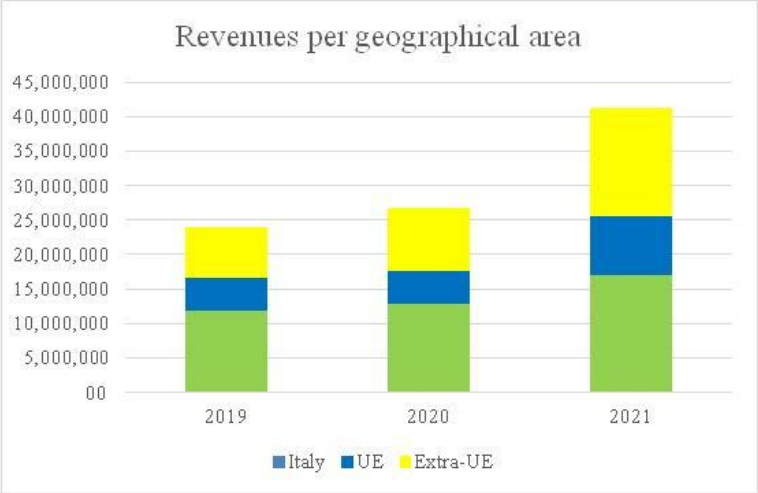
The company, despite huge investments that doubled its fixed assets in the three-year period and, therefore, generated a significant financing requirement, kept its exposure to external lenders constant in absolute terms, significantly reducing leverage from 1.22 in 2019 to 0.43 in 2022, making itself even less financially dependent on external lenders.

Allocation of earnings	2019	2020	2021
Net earnings of the year	2.030.438	2.857.032	3.876.712
Dividends paid	00	00	00
Legal reserve	101.522	142.852	193.836
Extraordinary reserve	1.928.916	2.714.180	3.682.876
Retained earnings	2.030.438	2.857.032	3.876.712
Percentage of earnings retained	100%	100%	100%

In fact, an analysis of the company's financial statements shows an important level of self-financing: it did not distribute the earning for the 2019, 2020 and 2021 financial years. This strategy was necessary to support the development and growth process that the company is facing, as well as to strengthen its capital base to face the economic situation, which, however, has not negatively affected the company's results. The high amount of non-cash costs, due to the significant fixed assets in the balance sheet, and the 100 % earning retention rate ensured an important source to be used in investments and hiring of resources.

P&L	**2019**	**2020**	**2021**
Total revenues	24.063.341	27.454.873	42.864.060
External costs	(16.035.682)	(16.655.937)	(27.331.632)
Value added	**8.027.659**	**10.798.936**	**15.532.428**
Personnel costs	(4.948.704)	(5.042.479)	(7.314.102)
EBITDA	**3.078.955**	**5.756.457**	**8.218.326**
D&A	(1.302.949)	(1.666.726)	(2.571.425)
EBIT	**1.776.006**	**4.089.731**	**5.646.901**
Financial and non-operating income and expenses	773.030	(170.069)	(140.196)
Depreciation of participations	00	(413.017)	(431.865)
EBT	**2.549.036**	**3.506.645**	**5.074.840**
Income taxes	(518.598)	(649.613)	(1.198.128)
Net Profit	**2.030.438**	**2.857.032**	**3.876.712**

Indeed, the company has seen its revenues grow by almost 70 per cent over the last three years (2019-2021) rising from around 24 million to over 40 million, despite the global economic crisis resulting from the COVID-19 pandemic. This is certainly thanks to the sector to which they belong: household and home care products have not suffered a reduction in consumption, on the contrary, they have seen an increase in demand due to the increased time people have spent at home and the importance that the domestic environment has once again assumed. In the last years the company started to sell its products on its own, and under its own brand, contrary to what it used to do in the past but still keeping corporate clients as well. Is possible to assume that entering the market, especially international, under its own brand name and with the 'Made in Italy' label, has contributed to this increase in sale, even in foreign markets.



Also, however, to the great ability to establish itself abroad, especially in the non-EU market, where it doubled its sales from 2019 to 2021, enjoying great success in the Chinese market. Through its subsidiaries, Chinese and German ones in particular, has practiced very effective marketing policies to increase sales abroad. The company presents itself as the first and unique Italian player in the composite sink industry at the high end of the market.

As demonstrated in literature this surplus value of the products, due to the intangible assets owned by the firm, generate a highest willingness to pay for the goods produced by the firm.

This testifies and corroborates what emerged from the literature study, i.e., the great appeal of Italian products on foreign markets, especially the Chinese one. The company, in fact, has implemented an internationalisation strategy strongly focusing on the link with the territory and on 'Made in Italy'

Proof of this strong link to the territory are the investments in high-tech plant and equipment, the implementation of an ISO 14001 environmental management system (the company is already UNI EN ISO 9001 certified) and the recruitment and training of new employees for the Italian plant.

4 Conclusions and future research

This paper analysed the expansion process of an Italian manufacturing company during the Covid- 19 pandemic and the mix of funding sources used to

finance the expansion. The growth was possible thanks to the strong focus of the brand, identified as made in Italy. So the value created is closely connected to this intangible asset.

In companies with a family shareholding structure, this problem of the trade-off between earning retention and shareholder satisfaction is eliminated, since shareholders and managers, or in any case the decision-makers regarding dividend policy, are identified in the same nucleus of persons. In the case of this study, it is possible to observe how the use of internal sources was correctly utilised in order to increase the profitability of the company, both in relation to the operational area and the overall company, thereby increasing its value.

The entrepreneur's renunciation of his own remuneration in the short term created value for the company, which through a virtuous circle increased its revenues and earnings, generating an increase in equity value.

It is therefore clear that the use of internal sources, in particular retained earnings, was decisive in order not to incur additional costs for financial charges and not to have to repay the capital at predefined maturities.

The waiver of earnings by the entrepreneur was a highly ethical behaviour for the company and the territory, guaranteeing jobs directly, through new hires, and indirectly through plant expansion works.

In addition, the company that strengthens its capital structure, invests in innovation and environmental sustainability, and carries out research and development and staff training make itself more financeable by the banking system (Bianchi and Ricco, 2022).

The present investigation has the limitation of having been carried out with a manual approach on a single case study from the quantitative and qualitative information.

It can present the starting point for subsequent studies in the area of sustainability of the company's operations and ESG criteria. In fact, the company does not provide any information beyond the mandatory information in terms of the environmental and social impact of its operations.

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The Observatory for the Management of the UNESCO Site of Sassi of Matera: Cognitive Autopoiesis and Communities of Knowledge

Angela Colonna

Department of European and Mediterranean Cultures.
Architecture, Environment and Cultural Heritages
University of Basilicata
Campus Matera, 20 Lanera st.
75100 Matera (MT), Italy

Abstract

The UNESCO Chair on "Mediterranean Cultural Landscapes and Communities of Knowledge", University of Basilicata, research and experiment among others the concept of "Communities of Knowledge" inside the UNESCO site of the Sassi of Matera, contributing to the creation of the Permanent Observatory for the Management of the UNESCO site. The Management Plan (MP) for the UNESCO site of the Sassi was elaborated from a participatory process developed around the concept of "Community of Knowledge". Inside the MP, the strategical regeneration of the testimonial value and use of the UNESCO site - conceived as a cultural landscape of sustainability and harmony between human settlements and nature-, is to understand and operationalize the power of knowledge for the valorization of the Sassi's world heritage, make it also a Mediterranean laboratory and a model too. The Observatory was conceived to work as a laboratory of sustainable development, declined on the topic of valorization of a territory, understood as a universal cultural heritage. The entire design process of the UNESCO Site Management Plan was interpreted as 'process of processes' with methodological and operational value. An analogue approach, principles and procedures will contribute to the creation of the Observatory. With the idea of 'process of processes', attention is drawn to the different logical levels to which actions belong, from attention to the object of investigation and project, to attention to the process itself. This attention develops effective cognitive and awareness processes to implement responsible and participative strategies for the heritage management, conceived as 'common'. The Sassi Observatory project also proposes an autopoietic organization, embracing through its strategies, tools and methods, the way life develops and evolves, i.e., learning from the process itself. Lastly, concerning the actualization of the UNESCO site's values, inside the Observatory, the dynamic process of Sassi's identity building- interpreted as a complex relationship between place, community and universal value- has been read through the concepts of "Community of knowledge" and "Generative narration of the landscape."

Keywords – Sustainability; UNESCO Heritage; Management Plan; Communities of Knowledge; autopoietic cognition.

Paper type – Academic Research Paper

1 Introduction

The Sassi Observatory is a tool envisaged by the Management Plan (MP) of the UNESCO site of "The Sassi and the Park of the Rupestrian Churches of Matera" and constitutes the management structure for the implementation of the Plan. The MP was drafted by Angela Colonna and Domenico Fiore, for the five-year period 2014-2019, twenty years after the Sassi were inscribed on the World Heritage List, in 1993. The MP was approved by the Matera Municipality in 2015.

Among the Observatory's objectives are two main tasks. The first task is to facilitate dialogue and collaboration between the public institutions responsible for the site, in order to harmonize their actions and activities, and orient them to the philosophy and strategy of the MP. The second task is the engagement of the population in the site management policies as a strategic action for the enhancement of cultural identity and awareness. Community engagement and dialogue between public institutions and stakeholders responsible for the UNESCO site are the cornerstones for the management of a site such as the Sassi, which is a part of the city, a part of the territory and, in essence, a cultural landscape. In both functions, dialogue is crucial, and the exchange and sharing of knowledge is the basis for building communities of knowledge.

The drafting process of the Management Plan developed along a path that began in 2011. In 2013, an intense participatory phase was carried out through a cycle of Symposia, interpreted as a creative, integrative and participatory environment for the shared construction of the MP; finally, the MP, scheduled for the five-year period 2014-2019, was drafted. The MP systematized contents collected, experiences of inter-institutional collaboration and community participation (envisioned ad 'knowledge bearers'), the working procedures used, and the methodological in-depth study. The structure of the MP itself is the result of the synthesis of the contributions of all the phases of the pathway. Moreover, the path that led to the definition of the Plan also constituted the experimentation for the definition of the process and method. To date, the MP has not yet been implemented, nor the Observatory, which is the instrument for

implementing the Plan, has been established. But some actions have been taken to urge public institutions to establish the Observatory. These actions were planned and implemented by the UNESCO Chair in 'Mediterranean Cultural Landscapes and Communities of Knowledge', established at the University of Basilicata in 2016, with A. Colonna as Chair Holder. The UNESCO Chair has among its objectives the facilitation of the launch of the Permanent Observatory for the management of the Sassi UNESCO site (Colonna 2018). The UNESCO Chair has worked both by designing the structure of the Sassi Observatory and developing its operational methodologies (The Observatory project has been developed by A. Colonna and D. Fiore in 2021), and by facilitating a bottom-up participation process aimed at experimenting with the realization of a self-managed core of the Observatory (*Participatory Document of Intent for the Observatory of the Sassi UNESCO Site*, drafted in 2019, for a bottom-up experimentation preparatory to the creation of the Observatory, concieved as a 'Community Foundation').In these activities, a number of specificities have been introduced that are an expression of the UNESCO Chair's competences and that constitute the core of its research: the experimentation of "Communities of Knowledge" and "Generative Narrative of the Landscape" concepts. These are two specific and interconnected functions, clearly identified in the executive project of the Sassi Observatory proposed by the UNESCO Chair. "Community of Knowledge" and "Generative Narrative of the Landscape" constitute two intertwined strategies to develop within the Observatory the process of actualizing the values of the UNESCO site (Colonna 2020): a path of dynamic construction of the identity of the Sassi has been realized, an expression of the relationship between the place, the community, and the universal heritage.

2 Community engagement and 'knowledge bearer'

The MP for the Sassi UNESCO site was defined around the principle of participation and was based on the idea of a 'community of knowledge'. (Colonna 2019) The entire design process of the MP revolves around the idea of the Plan as a process. Thus, already the path set in motion for MP drafting becomes the first experimentation concerning principles, procedures and tools for implementing the MP. In this path, the Symposia were conceived as workshops to facilitate discussion, comparison and the development of creative and shared ideas among citizens and public institutions. The cycle of Symposia, with which the

participatory process was launched, was also the occasion for experimenting a format with continuity over time, for the implementation of the MP. Thus, the workshop form had been selected; tools and methods of process facilitation had been implemented. The innovative idea experienced in the Symposia was to give back to everyone the responsibility of being a 'knowledge bearer', a competence that shifts the focus from the 'stakeholder' perspective and changes the way of contributing. The 'knowledge bearer' is a figure defined more on contributing, while the 'stakeholder' is centered more on receiving. The figure of the 'bearer of knowledge', which stands out in the Sassi MP, is a novelty precisely because it is an alternative to the 'bearer of interest', a figure that is more generally used in concerted planning processes and in the MIC-Italian Ministry of Culture Guidelines for the MPs of UNESCO Sites and for local tourism systems. With 'knowledge bearers' comes the emphasis on 'knowledge' because this is not only the primary wealth of the contemporary world, but also one of the places of solidarity between people. In contemporary times, a transformation is emerging in relation to the idea of identity. One of the possibilities is that identity will increasingly become the expression of a social bonds based on exchanges of knowledge, mutual listening and appreciation of individuals. Therefore, if today it is on knowledge that the wealth of nations and businesses is based, it is necessary to focus on a better management of knowledge, a strategic skill for the development of a knowledge society that is realized through the contribution of all. The ethics of collective intelligence is based on the model of cooperative learning where access to knowledge is conceived as access to the knowledge of all, and where the exchange of knowledge becomes a new form of social bonds, as each human being is a source of knowledge for others. Collective intelligence is not the fusion of individual intelligences into an indistinct synthesis, rather it realizes precisely the full expression and valorization of individuals and their mutual enhancement. The principle is that no one knows everything, but everyone knows something and everyone can be enriched by the knowledge of others. This awareness emphasizes the interdependence between people and the value of cultural diversity and knowledge heritages. In order to stimulate the enrichment of individual cultural landscapes, it is necessary to invest in tools and methods to facilitate effective communication and spatial representation of each other's and groups' knowledge. To this end, a work of translation into schemes and structured maps can be particularly effective so that everyone can recognise themselves and can find their own knowledge paths. An operational tool, which

still offers much to explore and experiment with, is 'knowledge trees' by Michel Authier and Pierre Lévy. (Authier and Lévy, 2000) This is a tool for the dynamic management of the competences of individuals and groups, in which it is social interaction that is brought into play in a systemic sense through co-constructions of 'knowledge trees'. In this sense, knowledge is not only the primary wealth of the contemporary world, but also becomes one of the places of solidarity between men. The reciprocal multiplication of intelligences can not only be the key to economic success, but can also be one of the ways to the renewal of democracy: a society that is 'intelligent everywhere' will always be more effective than one that is only intelligently governed. The idea of knowledge bearers' is central to the MP and its implementation process, because it is the basis on which to imagine the evolution of the Matera community towards a 'community of knowledge'. Facilitating the process of evolution of the Matera community as a Community of Knowledge is one of the experimentation objectives of the Permanent Observatory.

3 Logical levels and autopoiesis

Just as the entire design process of the UNESCO Site MP revolved around the idea of the Plan as a process of processes, and each activity was also an experimentation of the method, in the same way the same principle and approach is proposed in the realization of the Observatory. (Colonna and Fiore 2012) In the idea of process of processes, the focus is on the different logical levels to which the actions belong, from attention to the object of investigation and design to the process itself. (Watzlawick, Weakland and Fisch, 1974) Such attention develops effective cognitive and awareness processes to implement responsible and participative strategies for the management of the common heritage. An autopoietic organization is proposed for the Sassi Observatory, which makes its own, declining it in strategies, tools and method, the way life develops and evolves, i.e., learning from the same process. Living systems are cognitive systems, and life as a process is a process of cognition. The theoretical reference of the model derives from the discoveries made by Humberto Maturana in the 1970s, concerning the organization of living beings (investigating the nervous system, with parallel conclusions on the cognitive system), conceived as living systems that have a 'circular organization'; living beings have a closed causal circular process at the core of their basic organization. This process allows

evolutionary change, which consists of changing the way in which circularity is realized, never losing the very characteristic of circular organization. Furthermore, Maturana hypothesized that the nervous system is not only self-organizing, but continually referring to itself. On these premises, Humberto Maturana and Francisco Varela coined the term 'autopoiesis' to develop a model representing the way living systems, mind and cognition function. Research has developed from Varela's 'neurophenomenology' to cognitive neuroscience studies, adding further verification and detail to that model. (Maturana and Varela, 2001) It is the way we know, learning to learn, continually redefining the balance within the circular process, and, by evolving, reorganize that circularity in an ever-new way, along a process by logical steps. In fact, the Observatory project proposed by the UNESCO Chair envisages its realization as a modular organization, with a cluster structure of modules, which makes it possible, through continuous monitoring, to make revisions and improvements *in itinere*, to develop learnings that are applied in the definition of subsequent modules, to have greater control of sustainability and to practice it widely, to effectively apply criteria of sobriety, replicability and implementation. Thus, a path made up of progressive activation of actions-implementing the Observatory's structure horizontally and flexibly, according to feasibility conditions and assessing the opportunities at any time along the way always with an overall perspective and strategic vision - makes it possible to progressively reach new levels of complexity over time, while still functioning as an organic whole at every stage of development. The overall functioning responds to the principle of 'circular organization', in which each element acts on the next, and the ring acts retroactively on the process ('retroactive ring' of the autopoietic model), to stay the course, continually correcting the trajectory *in itinere*. This operating structure of the Observatory is in line with the emergence, in this phase of epistemological change, of procedural wisdom in place of the rationality of technical solutions, just as the need for the intertwining of specialized disciplinary knowledge and widespread, multiple knowledge practices emerges. From these also derived a new positioning of the interweaving of knowledge and doing, the role of practices, the continuous monitoring, the modular structure of project interventions (as laboratory modules), within a strategic overall framework.

4 A Mediterranean model laboratory

The MP of the Matera UNESCO site not only directs actions for a sustainable management, but also support a management that can become a model laboratory of sustainability, helping to spread the culture of sustainable development and to accelerate the transition to what in the MP is defined as the 'ecological paradigm'. The relevance of this change inside the MP can be seen in the MP Synthetic Map which, by grasping the relationships between the cognitive elements and the planning indications, is conceived as crucial tool to navigate within the Management Plan and the Action Plan; it had been also a working tool during the drafting process of the MP document, shading light on the complex relationships and connections between the different elements, levels and orders of discourse (Management Plan, Annex, 2014). Making the Sassi a Mediterranean model laboratory for sustainability is the MP's objective. In fact, the model that the Plan wants to realize is that of the 'Mediterranean Rupestrian Ecosystem', as the rehabilitation of the historical model and its actualization. The MP embraces the idea of drawing on the strength of the traditional model of the Sassi to nourish the new ecological paradigm, updating that archaic Mediterranean model and experimenting in Matera a laboratory of environmental and social sustainability for humanity. Matera's civilization is a successful experiment, that has worked for millennia, of appropriate use of scarce resources and ingenuity in landscape creation. The local solution is the creation of a functioning model with which global challenges and urgencies are addressed, and which concerns also energy and the sustainable use of resources (including water). This challenges the way of interpreting man's relationship in and with nature; a paradigm that has remained unchanged over a very long time, coinciding with the history of rural civilization. In that same millennial time, the model has been continuously refined, until it fell into disuse, along with the abandonment of the settlement, with the displacement of the Sassi in the 1950s. The strategy for the regeneration of the testimonial and use value of the UNESCO site -conceived as a landscape of sustainability and harmony between human settlement and nature-, is to use the power of knowledge and care for the valorization of the Sassi's World Heritage, and to make it a model Mediterranean laboratory. The cultural model expressed by the Sassi ceases to function when the paradigm changes, i.e., when the approach to the global issue of resource use changes. With the advent of the contemporary age, the paradigm of the 'limit', the very idea of man as part of

nature and subject to its rhythms and rules, is replaced by the paradigm of unlimited 'progress' in which man dominates an adverse nature. This has brought to a stop to long-lasting process of refining the model in the continuity of the criteria that had produced it and its landscape; this had led to the misunderstanding and loss of meaning of the site for its community. The community-driven and integrated management of environmental resources and space disappears and led to degradation of the whole system. In the 1950s, the Sassi were branded as 'national disgrace' and evacuated because of the interruption of the link with its community which had disabled and distorted the system and subtracted its meaning, leading to the collapse of that age-old ecological model. Today, in order to address the urgent environmental problem, there is a widespread consciousness regarding the need for an 'ecological transition'; issues of sustainable development, containment of the environmental footprint, use of renewable energy, and sobriety are posited as priorities. This new paradigm is the one within which the strategy of the Plan and its implementation through the Sassi Observatory is placed.

5 Conclusions

The Observatory for the management of the Sassi UNESCO site, therefore, had been designed to operate as a laboratory of sustainability and co-creation of a Mediterranean model for the experimentation of sustainable development, declined through the issue of the valorization of a territory as a universal cultural heritage. Knowledge is the strategic resource for the epistemological revolution to be achieved. But it is a knowledge that must be associated with the growth of self-awareness, a knowledge as a widespread resource, a tool for the existence of communities; knowledge as practices of coexistence with the planet Earth that hosts us. In this sense, knowledge can structure a new form of community and the construction of identity processes: a 'community of knowledge'. The valorization of knowledge as an autopoietic process has inspired the operating structure of the Sassi Observatory and of the entire MP system, conceived as a process that in turn activates processes. The autopoietic process of knowledge is the very expression of the way life is organized and functions. The foundation of the MP and the Observatory one these understandings constitute an orientation towards sustainability, it is also an incentive for a sustainable approach to address the radical change necessary for human evolution.

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Digital Transformation and Green Transition in the Shipbuilding Industry: Insights from the METROPOLIS Project

Silvia Baldassarre

Università Degli studi di Napoli Federico II
Piazzale Tecchio 80, 80125 Napoli, Italia

Giuseppe Bruno

Università Degli studi di Napoli Federico II
Piazzale Tecchio 80, 80125 Napoli, Italia

Manuel Cavola*

Università Degli studi di Napoli Federico II
Piazzale Tecchio 80, 80125 Napoli, Italia

Antonio Diglio

Università Degli studi di Napoli Federico II
Piazzale Tecchio 80, 80125 Napoli, Italia

Carmela Piccolo

Università Degli studi di Napoli Federico II
Piazzale Tecchio 80, 80125 Napoli, Italia

Eduardo Pipicelli

Università Degli studi di Napoli Federico II
Piazzale Tecchio 80, 80125 Napoli, Italia

* *Corresponding author*

Abstract

Collaboration with external innovation drivers is one of the opportunities that companies, especially if belonging to more traditional sectors, can seize to embark on a twofold path oriented towards both a sustainable horizon and a Digital Transformation goal. This is the case of the Palescandolo Lavorazioni Siderurgiche, which works in the traditional sector of shipbuilding, in particular, providing steel beams and sub-assemblies to shipbuilders of the

calibre of Fincantieri. In this context, the company developed a project (METROPOLIS) in partnership with the Department of Industrial Engineering of the University of Naples Federico II in order to exploit the potentiality of Digital Transformation to improve efficiency and reduce environmental impact. Once described the production system of the company and the main steps of the project, the aim of this paper is to show how the implementation of a Digitalization Plan represents a fundamental premise in order to allow the development of optimization-oriented approaches for operations management and the collection of data related to the environmental impact, making the latter become a new aspect that can guide decision-makers. In particular, we will analyse the opportunity provided by a DSS solution in managing objectives oriented on one side on efficiency and on the other side on sustainability, letting emerge the need for multicriteria approaches able to capture and drive the complexity of systems in which these objectives conflict.

Keywords – Digital Transformation, Shipbuilding, Decision Support System, Green Transition, Operations

Paper type – Practical Paper

1 Introduction

The primary goal of the European Green Deal is to arrest the climate crisis reaching net zero greenhouse gas emissions in the EU by 2050 (Haines & Scheelbeek, 2020). Among the multiple related effects, the deal seeks to protect the citizens' health from environment-related risks and repercussions (Eu, 2019) through the implementation of effective policies in various sectors that have a significant impact on global emissions, such as the energy, housing, transport, food, industry, and healthcare sector (Haines et al., 2009). At the same time, while Digital Transformation (DT) has become vital for the stable growth of companies and represents one of the strategies to increase product quality and make production processes more efficient (Duraivelu, 2022; Tortorella & Fettermann, 2018), technological advances are enabling more efficient use of resources and waste reducing, opening the way to new sustainable developments also from an environmental point of view (Li, Dai, & Cui 2020; de Sousa Jabbour et al., 2018; Ghobakhloo, 2020).

Along the path linking DT and environmental impact, one of the main pillars is represented by new industrial policies able to support product and process transformations toward the use of more sustainable technologies. Indeed, social and regulatory dynamics are exacerbating the enacting of policies that press companies to make them embark on a path oriented towards a sustainable

horizon (Para-Gonzalez & Mascaraque-Ramırez, 2020; Caniëls, Gehrsitz & Semeijn, 2013).

However, the potentiality of these interventions is strictly related to the company's specific industrial sector, size, and position. In this regard, the most traditional sectors seem to have a lower digitalization trend due to reasons related to limitations in the infrastructure upgrade and technology availability (Alexandrova & Poddubnaya, 2021). One of these sectors is undoubtedly represented by the shipbuilding sector, in which the current industrial practices are still linked to traditional approaches (Kolić, Fafandjel & Zamarin, 2012, Centobelli et al. 2023). This misaligned evolution of the sector that reduces the boost to innovation depends on different factors: the oligopolistic characteristics of the market with very high entry barriers, the complexity of the final products and its supply chain, the high degree of customisation, the wide presence of labour-intensive operations (Gourdon & Steidl, 2019; Sánchez-Sotano et al., 2020).

In this context, we describe the experience of *Palescandolo Lavorazioni Siderurgiche* (PLS), one of the leading Italian suppliers of Fincantieri, the world largest cruise shipbuilding group (BRS, 2022). The company operates in the metal carpentry field, producing welded beams and sub-assemblies used for the building of cruise ships and ferries. Due to the absence of any form of production standardization, the production organization is very traditional with a very basic degree of digitalization. In this context, the company developed a project (METROPOLIS) in partnership with the *Department of Industrial Engineering* (DII) of the *University of Naples Federico II,* in order to exploit the potentiality of DT to improve the efficiency and to reduce the environmental impact. The project was developed in the framework of an Italian institutional program sponsored by the Economic Development Ministry (MISE) to promote innovative projects able to support Small and Medium Enterprises in process transformations.

The description of the projects and of the preliminary obtained results is interesting from many point of views. Its implementation has been highlighting the challenging aspects related to the introduction of form of DT within a very traditional sector. In addition, it allowed to show what are the practical difficulties in combining the attention toward the sustainability of the processes with the need to assure level of service as high as possible to respond to the pressing requirements of the market.

The remainder of the paper is organised as follows. In Section 2, we describe the characteristics of the productive context of PLS and the critical problems related to the logistic and production organization. Then, in Section 3, we describe the objective of the project and its main steps. Section 4 presents the characteristics of the DT introduced Finally, in Section 5 the relationship between digitalization and evaluation performance is explored, and in Section 6 we close the paper with some conclusions.

2 The PLS production system

PLS is one of the leading Italian suppliers of Fincantieri, the world's largest cruise shipbuilding group (BRS, 2022) and it operates in the metal carpentry field, producing welded beams and sub-assemblies used in shipbuilding for the building of cruise ships and ferries. Production is Make to Order, in the sense that, on the basis of the specific ship to be produced, Fincantieri provides the list of items that PLS has to supply. Items are grouped into batches, and each of them is characterized by a due date within which the batch should be completed and delivered to a final destination.

Each item is defined on the basis of a specific and unique technical drawing to be respected and has to be delivered according to a deadline. To have a picture of the technical and operational complexity of the process, just consider that the input materials of the PLS are principally represented by steel slabs that can reach 18 meters in length and exceed 3 meters in width; while the components (Part Number – PN) of the beams (obtained by the cutting of the slabs) may vary from few centimetres to some meters of length and/or width. Annually, the PLS produces about 15000 final items, starting from about 1000 steel slabs.

On the basis of the morphological and physical characteristics, items can be grouped into 5 different classes or families. After the cutting of the input steels, the production cycles of each PN generally involves the routing through various production cells where labour-intensive operations are performed with the support of dedicated machines. Figure 1 shows the layout of the production plant with the indication of 13 cells of production (from 3 to 15) and four storage areas (1, 2, 16, 17).

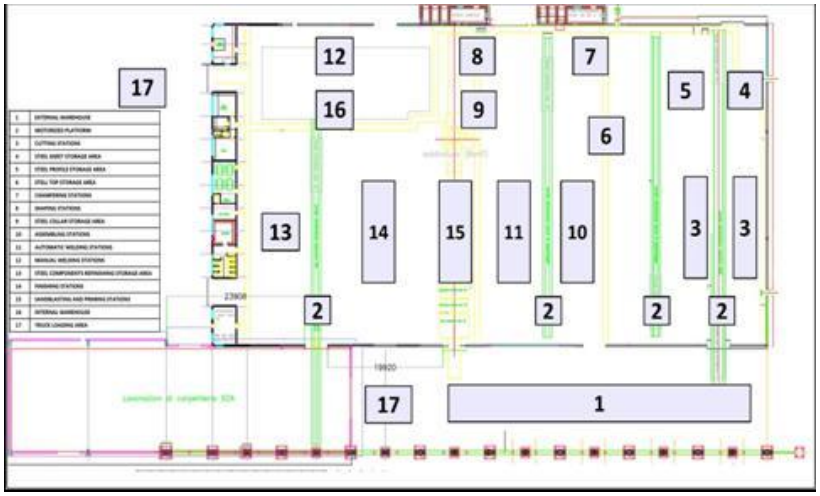

Figure 1 – Layout of the PLS production plant

The core of the production process is the cutting operation (cell 3) which is fed by the so-called nesting generation process, which consists of the definition of cutting schemes of the input materials to generate the required components followed by the consequent cut of the slabs. Once the cutting operation is executed, each PN follows different *operations routing* (the typology and sequence of operations) on the base of the PN characteristics. Finally, in the assembly phase all the PNs are collected and assembled so that the item can be stored in an output area (cell 1 or 16).

The described process presents various critical aspects. First of all, each family of items is characterized by different routing sequences, as shown in Figure 2. Consequently, the production process presents a low level of efficiency with long waiting times for single PNs at each cell due to the difficulties in coordinating the operations planning.

This aspect is typical of a Job Shop production scheme which is considered one of the hardest production contexts to be managed (Chaudhry et al. 2016). In the specific context, the difficulties are exacerbated by further determinants: the lack of a tracking system able to monitor the production progress, and the time consumption for the cell to cell handling operations due to the need of using special machines such as overhead cranes. Therefore, a significant percentage of the available time for production is lost to detect the actual position of PNs in the plant. In this regard, Figure 3 shows at each cell, the percentage of the actual processing time in relation to the total available time.

Another indicator which underlines the significant inefficiency of the whole production system is the level of service in terms of ability to satisfy the due dates indicated by the customer. Analysing a sample of produced items started in a time window of 6 months, over a total number of 6709, 4583 items, corresponding to 68,3%, were completed after the due date, with an average delay of 21 days and maximum delays over three months.

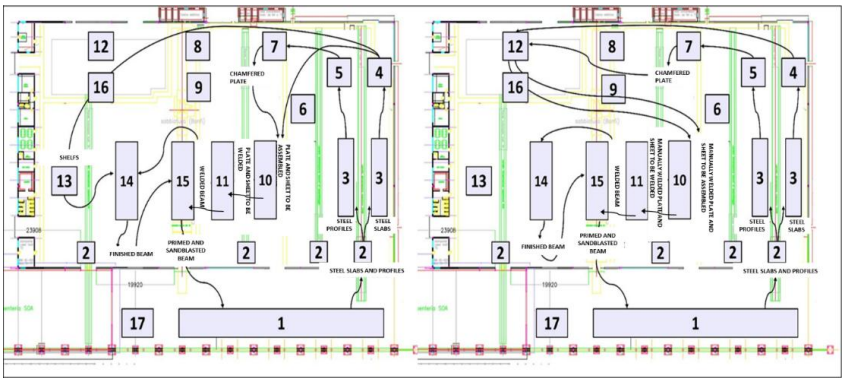

Figure 2 – Example of different production routing

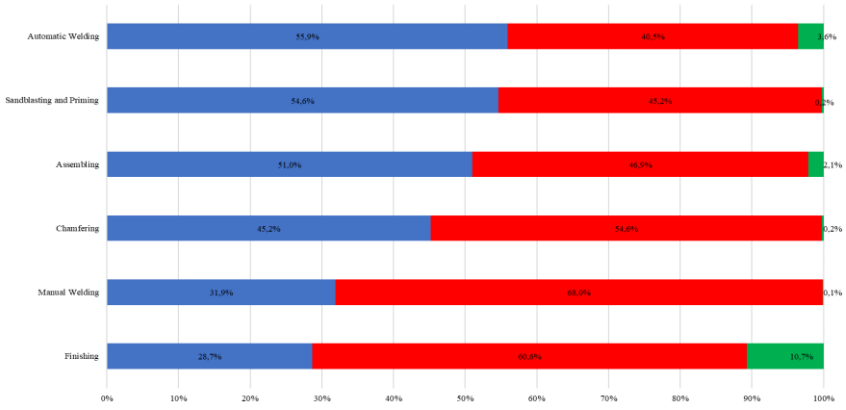

Figure 3 – Processing time (blu), waiting times (red), handling times (green)

Analysing the current production and logistic system, various critical aspects may be identified: the inappropriateness of the physical and information flows tracking system; the lack of a framework to monitor and to evaluate system's performance, especially in terms of sustainability; the absence of optimization-oriented approaches for operations management. More precisely, the current information tracking system is based on the application of paper labels which are

updated, duplicated, and printed at each production cell. Therefore, the system is susceptible to many kinds of errors, such as incorrectness and/or delay in the provision of information. Then, the data recording mechanism does not allow the company to monitor the production progress in real-time, making it impossible to intervene promptly to resolve any delays or operational problems and compromising the management of subsequent production planning.

Concerning the environmental impact, PLS currently does not collect any direct data related to waste production and energy consumption. Therefore, there is no evaluation about the sustainability of the production processes.

3 The METROPOLIS Project

Starting from the described organization of the production and logistic system, the PLS opted for developing the Metropolis project in partnership with the *Department of Industrial Engineering* (DII) of the *University of Naples Federico II,* in order to improve the efficiency of the whole production system. The project adheres to the field of the "*Smart factory*" concerning technological solutions for the optimization of production processes and industrial automation, the integrated management of networked logistics, the use of advanced Information and Communication Technologies (ICT) for the virtualization of transformation processes and systems for the enhancement of people in factories (MISE, 2018), in line with the *National Strategy of Smart Specialization* related to the "evolutionary and adaptive production systems for customized production".

The duration of the project was 36 months and is articulated on 11 different *Realization Objectives* (RO), split into two categories the *Industrial Research* (i.e., planned research or critical investigations aimed at acquiring new knowledge and skills to be used to develop new products, processes or services or to make a significant improvement to existing ones) and the *Experimental Development* (i.e., the acquisition, combination, structuring, and use of existing scientific, technological, commercial and other knowledge and capabilities to develop new or improved products, processes or services).

The project aimed to implement a radical change in the production and logistics system on the basis of three main pillars. The first pillar was represented by the design and development of a Digitalization Plan in order to monitor and, consequently, manage in real-time the production processes, integrating it into the pre-existent ERP. The second pillar consisted of the definition of a set of KPIs

(Key Performance Indicators) able to describe the different dimensions of the production environment: specific attention was paid to identifying appropriate KPIs to describe and predict the level of service, also considering the expected trend of growth in demand. The third pillar is constituted by the role assumed by the sustainability objectives in the re-organization of the production process in a context of medium and long term.

The practical output of the project was the design and the implementation of a *Decision Support System* (DSS) able to offer decisional alternatives in the production planning and control in order to combine classical efficiency targets with environmental impact aspects.

Now the project is living in the final phase of experimentation of the adopted solutions. In the following the first results obtained during its realization are described.

4 The Digitalization Plan

The design and the implementation of a Digitalization Plan (DP) represented a necessary premise for the innovation of the production and the logistic system. The main objectives were (a) the design of a Data Warehouse Management (DWM) architecture in order to extract, transform and load data provided by external sources logically distributed along the production processes, (b) the elaboration and selection of appropriate subsets of data to allow the definition of models able to support decisions about the operations planning, (c) the calculation of a set of KPIs in order to monitor and evaluate the production and environmental performances. In practice, the data transmission and collection system, the connection tools between operators and the information system, and the desk and mobile interfaces (dedicated to the individual workstations) were defined.

The architecture is based on a LAN and a Wi-Fi network for the connection to various desks and mobile devices and a server rack where data extracted from different sources are stored. In order to collect data in real time, a network of sensors, based on different technologies, was installed. The main innovation is represented by the labeling procedure, which is performed as each PN is produced while information (position, processing times, waiting times) are automatically updated through infrared technologies.

The implementation of the DP, now completed, has been permitting the collection of a huge amount of data which are currently used to evaluate the performance.

5 The environmental impact evaluation

Data collection, performed thanks to the implementation of the DP, has permitted a first analysis of the environmental impact of the production processes. To this aim, a methodology based on the *Life Cycle Analysis* (LCA) was applied. In particular, starting from the raw material inputs (steel slabs and profiles) and considering the entire production process, including the delivery phase, the material and energy consumption was evaluated and converted to CO2e (carbon dioxide equivalent). Figure 4 shows the contribution of each production/logistic operation to the environmental impact in terms of CO2 equivalent production.

The cutting operation is particularly critical as two of the most impacting contributions according to the considered categories (*Damage to human health*, *Damage to ecosystems*, and *Damage to resource availability*) are the oxygen utilized during the cutting process and the steel production of the input material. For this reason, reducing the cutting operations would have a significant positive environmental impact.

Considering that the cutting operation is the initial process that provides the PNs, so crucially conditioning the production performances, it is fundamental to define appropriate methodologies able to appropriately manage this operation. This is the core of the DSS that has been developed to drive appropriate production planning decisions.

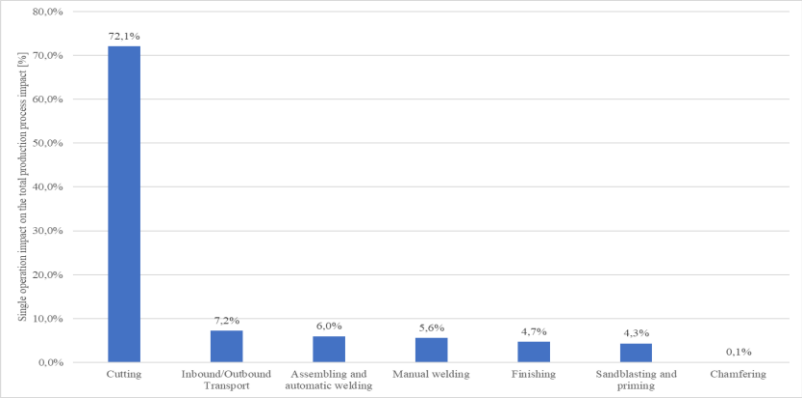

Figure 4 – Distribution of CO2 production over the production/logistic operations

6 Efficiency vs. sustainability: the opportunity provided by a DSS solution

As illustrated above, the cutting operation has a crucial role in the described production for two main reasons: it is responsible for the prevalent percentage of CO2e; it affects the production progress by determining the release times of each PNs included in the items. Therefore, an efficient management of this process is fundamental in order to improve the desired system performance.

The cutting or nesting optimization, in general, arises in the presence of a set of bins of a given capacity that have to be partitioned according to a set of objects of given dimensions to be produced (Kellerer, Pferschy, & Pisinger, 2004). In our case, bins are rectangles of a given length and width that have to be cut according to the bi-dimensional characteristics (occupation, shape) of the PNs in the lists of the items. In order to have an idea of the problem, Figure 5 shows an example of the output of a nesting procedure which highlights the complexity of the decision problem.

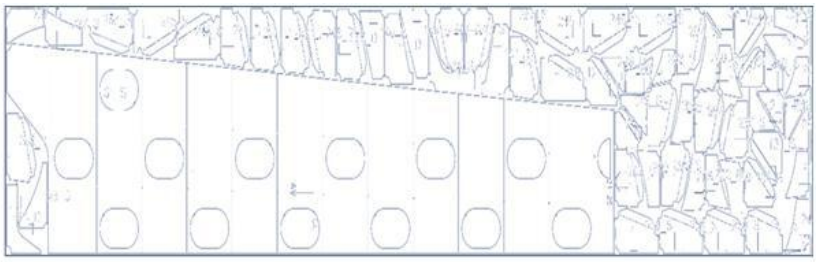

Figure 5 – An example of nesting output

Especially in this bi-dimensional version and in relation to the huge number of PNs to be produced and variety of their morphological dimensions and shapes, it is a very hard optimization problem (Cacchiani et al., 2022) whose solution requires the use of specific heuristic algorithms. Currently, the nesting decision is performed empirically on the basis of the experience of the employees and without the support of any optimization tool.

However, the criteria used to determine the nesting can be different in dependence on the adopted objectives. In the case of steel waste minimization, for instance, PNs should be chosen on the basis of their occupancy and shapes but independently on their belonging batch and, consequently, of its due date. This option may produce good results in terms of sustainability as it reduces energy consumption and material wastes due to the minimization of used steel slabs; however, it can negatively affect the level of service as it leads to an increment of the required time to obtain all the components of the same batch. On the other hand, if nesting rules are adopted in order to give priority to PNs belonging to the same batch, this has positive effects on the logistic performance, but it may increase the environmental impact.

These two conflicting objectives point out that, in some cases, sustainability objectives are not in line with efficiency targets. For this reason, a DSS was proposed in order to drive decision makers in this context. The fundamental elements of the DSS are: (a) a heuristic algorithm able to perform the nesting procedure defining, as objective function, a trade-off between sustainability objectives and the level of services; (b) a set of dispatching rules to be locally applied at the level of single production cell to foster production progress. The first results obtained in testing the DSS show the ability of the system to drive the decision maker.

7 Conclusions

The shipbuilding industry is one of the industrial sectors where logistic and production operations are still based on traditional procedures. The introduction of digital practices, in this context, generally requires huge investments and long-term pervasive organizational restructuring programs. One way to overcome the limited boost to innovation due to the peculiarity of the context is represented by collaboration with external innovation drivers, such as academic institutions. In this paper, we described the first results obtained thanks to the implementation

of a project financed in the framework of the Italian Strategy of Smart Specialization. The project may represent an example of fruitful cooperation between a medium enterprise belonging to a traditional industrial sector and academic institutions.

The aim of the project was to promote innovation through radical transformations of the logistics and production operations thanks to a pervasive DT, which should represent a premise for a continuous improvement of production and sustainability performances.

The description of the results provided during the implementation of the project highlights the general complexity of the needed interventions and the potentialities offered by a profound digitalization transformation. However, we stressed how the DT represents a necessary but not sufficient condition to obtain significant performance improvements. To this aim, it is necessary to introduce appropriate supports based on advanced methodologies able to capture and drive the complexity of the system. In particular, we showed, as usual in practice but superficially underlined in theory, that efficiency objectives and sustainability issues may be in conflict. Then, in order to take into account both aspects, multicriteria approaches should be adopted.

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Exploring Urban Resilience: An Analysis of Threats, Goals, and Stakeholder Engagement Practices

Giuseppe Forenza*

Politecnico di Bari
Department of Mechanics, Mathematics & Management
Via Orabona 4, 70126 Bari, BA, Italy

Francesco Paolo Lagrasta

Politecnico di Bari
Department of Mechanics, Mathematics & Management
Via Orabona 4, 70126 Bari, BA, Italy

Pierpaolo Pontrandolfo

Politecnico di Bari
Department of Mechanics, Mathematics & Management
Via Orabona 4, 70126 Bari, BA, Italy

Barbara Scozzi

Politecnico di Bari
Department of Mechanics, Mathematics & Management
Via Orabona 4, 70126 Bari, BA, Italy

** Corresponding author*

Abstract

In the last decades, a broad scientific debate - which involves the fields of engineering, psychology and ecology among the others - has been developed on the concept of resilience. The broadness of the debate highlights the need to define new models for the management and development of cities and territories in a holistic perspective. Many models and tools developed to improve the resilience of cities converge in recognizing the fundamental role of stakeholder engagement in developing more resilient communities. However, initiatives launched by local, regional, national, and international governments and organizations often fail to involve urban stakeholders, who are the first to suffer the risks of living in fragile systems. In the study, by using a systematic literature analysis protocol, the authors explore the domain of urban resilience initiatives, with a particular focus on resilience dimensions and goals, addressed threats, involved stakeholders, and employed stakeholder engagement practices. The content analysis conducted on 57

initiatives has highlighted the centrality of water management as one of the main objectives in urban resilience initiatives. The analysis showed that the initiatives are mainly designed to manage chronic stresses. Additionally, the results highlight that local governments, citizens and public and private companies constitute the main involved stakeholders, whereas workshops and interviews represent the most adopted stakeholder engagement practices.
From a theoretical point of view, the research contributes to enriching the state of the art on the concept of resilience by collecting knowledge about real-world initiatives. Furthermore, the paper presents some policy implications: it contributes to creating structured knowledge about urban resilience initiatives with a focus on stakeholder engagement so as to inspire and support policymakers interested in increasing stakeholder participation.

Keywords – Resilience, Urban Resilience, City, Stakeholder, Stakeholder Engagement

Paper type – Academic Research Paper

1 Introduction

In the last decades, a broad scientific debate - which involves the fields of engineering, psychology and ecology among the others - has been developed on the concept of resilience (Meerow & Stults, 2016; Zeng et al., 2022). The broadness of the debate highlights the need to define new models for the management and development of cities and territories in a holistic perspective. Urban systems, complex by their nature (Meerow et al., 2016), are increasingly exposed to stressors such as climate change, natural disasters, resource scarcity, environmental degradation and geopolitical crises, which threaten the entire urban ecosystem. These factors and their epiphenomena contribute to making the urban system fragile. That makes the development of strategies oriented towards preparation, absorption, transformation, change, and recovery in relation to shocks (Figueiredo et al., 2018) and the definition of tools capable of directing urban policies towards an increase in resilience necessary and urgent (Béné et al., 2012), as mentioned in 2030 Agenda (United Nations, 2015). In particular, SDG11 "Make Cities and Human Settlements Inclusive, Safe, Resilient And Sustainable" (United Nations, 2015) highlights the need to pay greater attention to urban planning and governance.

Resilience improvement strategies and processes can trigger new forms of urban governance (Duit et al., 2010; Schwanen, 2016), based on a multi-stakeholder participatory approach. Stakeholder participation is widely

recognized as a key element in the effectiveness of urban resilience initiatives. In particular, stakeholder engagement is the first step towards building self-reliant urban realities, equipped with systems of democratic participation in decision-making and able to proactively respond to acute shocks and chronic environmental, social and/or economic stresses (Baravikova et al., 2021; Kapucu et al., 2021).

Several programs and frameworks have been developed to guide political decision-makers in the implementation of interventions aimed at improving the level of resilience of cities (Béné et al., 2012). Despite the use of heterogeneous and not always overlapping dimensions, indicators and approaches, local, national and international political agendas and resilience frameworks converge in recognizing the importance of stakeholder engagement. For example, The City Resilience Index (ARUP, 2014), developed by Arup and supported by The Rockefeller Foundation, is a framework structured on four dimensions (namely, Health and wellbeing, Economy and society, Infrastructure and Environment, Leadership and strategy), 12 goals and 52 indicators to measure the resilience and provide a holistic representation of urban resilience. Three of 12 goals are aimed at assessing aspects related to to stakeholder participation, public involvement in decision-making processes and partnership among urban actors. The Resilience Maturity Model (Hernantes et al., 2019), developed as part of the Smart Mature Resilience project, one of the most important European projects on urban resilience, provides indications of initiatives implemented at the urban level to increase resilience along four dimensions, namely Leadership and Governance, Preparedness, Infrastructure and Resources, Cooperation. Great importance is devoted to stakeholders, to the point of prescribing their involvement in relation to the urban resilience maturity level. Therefore, it becomes crucial to adopt multistakeholder engangement approaches to implement transformative processes geared towards urban resilience.

The objective of the paper is to investigate the domain of urban resilience, starting from real-world initiatives, with a focus on stakeholders and stakeholder engagement. To this end, a systematic review of case studies reported in extant literature is carried out. After briefly introducing the concepts of urban resilience and stakeholder engagement, the authors identify a set of real-world resilience initiatives. For each initiative, the geographical area, the stakeholders involved, the engagement practices adopted and the addressed threats (e.g. stormwater mismanagement, earthquakes) are inductively identified. Additionally each

initiative is deductively characterized by adopting dimensions and goals provided by the City Resilience Framework (ARUP, 2014), one of the globally most known and implemented urban resilience frameworks.

From a theoretical point of view, the research contributes to enriching the state of the art on the concept of resilience by collecting knowledge about real-world initiatives. Additionally, the paper presents some policy implications. By providing a synthesis and classification of the main case studies, the paper contributes to creating knowledge about the main characteristics of the initiatives carried out on a global scale that may inspire and support policy makers interested to increase the urban resilience.

The paper is structured as follows. Section 2 presents the concepts of resilience and stakeholder engagement, which will guide the definition of the research questions. Section 3 presents the research protocol used by the authors to address the research questions. Section 4 presents and discusses the research results. Finally, implications and future research avenues are briefly discussed in the Conclusions.

2 Research Background and Rationale

In the Section we present the research background and the study rationale.

2.1 Resilience and city resilience initiatives

Urban resilience is the ability of a city to respond, adapt, and transform in the face of external threats. Threats range from natural disasters such as floods, earthquakes, and hurricanes, to human-made events such as public health crises, and terrorist attacks. Building urban resilience is crucial as cities become more populated and interconnected, and the risks associated with urban systems failure become more significant (ARUP, 2014; Meerow & Stults, 2016).

Resilience in the urban context has evolved from its initial conceptualization as engineering resilience, i.e. the property of a system to return to a previous equilibrium state after a disturbance. Today, resilience is understood as a multidimensional concept that includes ecological and socio-ecological perspectives (Meerow et al., 2016). Ecological resilience recognizes the multiple states of equilibrium in an ecosystem and the need to adapt to changing conditions. Socio-ecological resilience focuses on the adaptive capacity of social

and economic systems, while recognizing the need to transform and restructure them to cope with future shocks and stresses (Folke, 2006).

Urban resilience requires a coordinated effort among various stakeholders, including city governments, private sector actors, and local communities. It involves a range of activities, such as disaster preparedness planning, infrastructure investments, and community engagement. Building urban resilience is not only essential for mitigating the impacts of shocks and stresses, but can also provide benefits in terms of increased economic competitiveness, improved social equity, and enhanced environmental sustainability (Hernantes et al., 2019; Schwanen, 2016; Zeng et al., 2022).

In order to increase the resilience of urban systems over time, various public and private actors have launched initiatives, programmes, and policy agendas. Indeed, urban resilience initiatives represent a heterogeneous group of actions characterized by different objectives (e.g. planning, implementation, education) and affect very different urban contexts. Nevertheless, some policy and strategic frameworks tend to standardise the objectives and approaches of urban resilience initiatives. The Resilience Maturity Model, for instance, proposes a set of resilience initiatives structured to accompany urban realities in their path towards social-ecological resilience (Hernantes et al., 2019). The need to structure initiatives and structure them within frameworks addresses the demand to create global networks to foster awareness of resilience issues, dialogue and learning between cities, and longitudinal and vertical comparison of urban resilience performance.

2.2 Stakeholder engagement and city resilience

The term stakeholder refers to 'any group or individual who can affect or is affected by the achievement of the organization's objectives' (Freeman, 1984). Stakeholder engagement typically refers to a set of actions or initiatives undertaken by an organization to involve its stakeholders in various activities, ranging from decision-making processes to educational campaigns (Greenwood, 2007).

It is evident that urban actors constitute stakeholders of any urban resilience initiative: they not only benefit from the effects achieved by effective resilience initiatives, but also, and above all, suffer from the effects of failed resilience policies and strategies. The promoters of any urban resilience initiative cannot exempt themselves from strategically identifying and considering their

stakeholders, especially in a complex and delicate system such as the urban one (Hernantes et al., 2019). Placing urban stakeholders at the center of the processes that characterize resilience initiatives has proven to be a central aspect in determining the effectiveness of such initiatives (Petrescu et al., 2016).

Most of the frameworks geared towards urban resilience exceptional importance to stakeholder engagement (Chen et al., 2022; Gosain et al., 2022; Hernantes et al., 2019). As mentioned in the Introduction, many international projects aimed at promoting urban resilience include stakeholder engagement or neighbouring concepts (e.g. public participation), among their objectives. In some the level of resilience achieved is assessed based on urban stakeholders reached by city-level initiatives (Hernantes et al., 2019).

2.3 Research objectives and questions

The aim of the research is the exploration of urban resilience initiatives by identifying addressed threats, impacted dimensions, pursued goals, involved stakeholders, and employed stakeholder engagement practices. Therefore, starting from the assumptions presented so far, the following research objectives and questions were defined:

Research Meta objective: explore the domain of urban resilience improvement initiatives.

> *RQ-1: What are the addressed threats, the impacted dimensions and the pursued goals of urban resilience initiatives globally conducted so far?*
>
> *RQ-2: What urban stakeholders are currently involved in urban resilience initiatives?*
>
> *RQ 3: What engagement practices are currently adopted in urban resilience initiatives?*

RQ-1 aims to provide a structured representation of conducted urban resilience initiatives: as anticipated in previous Sections, resilience is a nuanced concept often associated to different meanings (Meerow et al., 2016). RQ-1 is formulated to investigate how resilience is meant in heterogeneous geographical and cultural contexts so as to confirm or enrich the conceptualisations provided by extant literature. RQ-2 was formulated to develop a taxonomy of stakeholders involved in urban resilience initiatives. Stakeholder involvement within resilience initiatives is widely advocated, especially when the resilience initiative is generated with a top-down approach, i.e. an institution acts as the main promoter and organizer of

the initiative (Petrescu et al., 2016). RQ-3 aims to identify the practices effectively used to involve urban stakeholders: governments, decision-makers and in general promoters of urban resilience initiatives may adopt a plethora of tools, including technological ones. If the success of an urban resilience initiative largely depends on stakeholder engagement, it is evident that the choice of the right engagement practice is central in determining its overall efficacy.

3 Materials and Methods

To address the research questions introduced in the previous Section, the authors developed a systematic literature review protocol aimed at identifying urban resilience initiatives conducted on a global scale. The methodology known as systematic literature review is a research approach used to explore a specific topic by examining extant knowledge (Tranfield et al., 2003). Originally designed for medical research to ensure consistency and uniformity in evaluating medical treatments (Boell & Cecez-Kecmanovic, 2015), this methodology has now been applied in various fields such as management (Tranfield et al., 2003), policy making and urban planning (Meerow et al., 2016). A systematic literature review enables the collection, assessment, and correlation of evidence from prior publications. This approach distinguishes itself from other review methods as it avoids biased analyses due to limited or irregular coverage of existing evidence. The systematic literature review is valued for its replicability, transparency, objectivity, and rigor (Boell & Cecez-Kecmanovic, 2015). The research pipeline used in this work was informed by (Xiao & Watson, 2019) and is depicted in Figure 1.

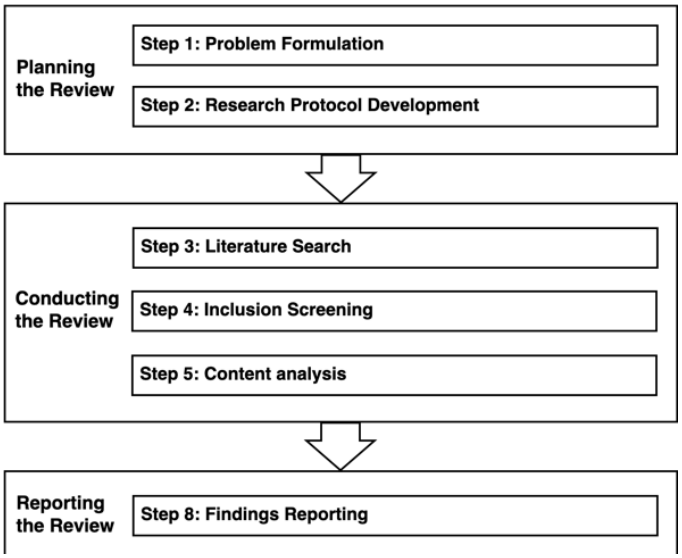

Figure 1: Research pipeline, derived by (Xiao & Watson, 2019).

The authors therefore designed a query aimed at collecting knowledge useful to address the formulated research questions. The following query was launched on SCOPUS scientific database (Burnham, 2006) in March 2023:

TITLE-ABS-KEY ((policy OR practice OR initiative) AND (stakeholder) AND (resilien) AND (urban OR city) AND "case study")*

In the first instance, the query returned a raw dataset to which inclusion criteria were applied, leveraging on the structured information provided by the database (e.g. document type, language). The filters applied are shown in Table 1.

Table 1: Inclusion criteria selected in the SCOPUS environment.

Variable	Inclusion criteria
Publication stage	Final
Document type	Journal article
Language	English

Following the application of the filters, the authors identified 108 scientific papers potentially relevant to the study. At this point, two of the authors read the abstracts and proceeded to exclude from the knowledge base those papers that were not useful for research purposes (e.g. not containing real-world initiatives).

This phase was conducted in parallel and blind between the two authors, who converged on a final dataset containing the 29 articles reported in Table 2.

Table 2: List of the selected documents.

Reference	Title	Year
(Gosain et al., 2022)	Understanding multisector stakeholder value systems on housing resilience in the City of Miami	2022
(Ray et al., 2022)	Transit-Oriented Data: The Importance of Data and Coordination to Transit-Oriented Urban Transformation	2022
(Huynh et al., 2022)	Destination Responses to COVID-19 Waves: Is "Green Zone" Initiative a Holy Grail for Tourism Recovery?	2022
(Shokry et al., 2022)	"They Didn't See It Coming": Green Resilience Planning and Vulnerability to Future Climate Gentrification	2022
(Göransson et al., 2021)	Territorial governance of managed retreat in Sweden: addressing challenges	2021
(Talebloo & Alias, 2021)	The evaluation of physical dimension on the design of campus buildings towards resilience initiative at the university of malaya	2021
(Mahajan et al., 2021)	From Do-It-Yourself (DIY) to Do-It-Together (DIT): Reflections on designing a citizen-driven air quality monitoring framework in Taiwan	2021
(McPhee et al., 2021)	The defining characteristics of agroecosystem living labs	2021
(Yoshioka et al., 2021)	Towards integration of climate disaster risk and waste management: A case study of urban and rural coastal communities in the Philippines	2021
(Fastenrath & Coenen, 2021)	Future-proof cities through governance experiments? Insights from the Resilient Melbourne Strategy (RMS)	2021
(Matamoros et al., 2020)	Hydrodynamic analysis of a stormwater system, under data scarcity, for decision-making process: The duran case study (Ecuador)	2020
(Fastenrath et al., 2020)	Scaling-up nature-based solutions. Lessons from the Living Melbourne strategy	2020
(Jeff Birchall, 2020)	Coastal climate adaptation planning and evolutionary governance: Insights from Homer, Alaska	2020
(Kurtsal et al., 2020)	Exploring governance mechanisms, collaborative processes and main challenges in short food supply chains: The case of turkey	2020
(Ndebele-Murisa et al., 2020)	City to city learning and knowledge exchange for climate resilience in southern Africa	2020
(van den Berg & Keenan, 2019)	Dynamic vulnerability in the pursuit of just adaptation processes: A Boston case study	2019
(van der Jagt et al., 2019)	Co-creating urban green infrastructure connecting people and nature: A guiding framework and approach	2019
(Lindsay, 2018)	Social learning as an adaptive measure to prepare for climate change impacts on water provision in Peru	2018
(Kiener et al., 2018)	Innovations in Gearing the Housing Market to Welfare Recipients in Osaka's Inner City: A Resilient Strategy?	2018

(Khazai et al., 2018)	Resilience Performance Scorecard: Measuring urban disaster resilience at multiple levels of geography with case study application to Lalitpur, Nepal	2018
(Francis et al., 2018)	Post-disaster reconstruction in Christchurch: a "build back better" perspective	2018
(Dubbeling et al., 2017)	Assessing and planning sustainable city region food systems: Insights from two Latin American cities	2017
(Petrescu et al., 2016)	Co-producing commons-based resilience: lessons from R-Urban	2016
(Connop et al., 2016)	Renaturing cities using a regionally-focused biodiversity-led multifunctional benefits approach to urban green infrastructure	2016
(Feldhoff, 2016)	Asset-based community development in the energy sector: energy and regional policy lessons from community power in Japan	2016
(Burnside-Lawry & Carvalho, 2016)	A stakeholder approach to building community resilience: awareness to implementation	2016
(Kourtit & Nijkamp, 2013)	The use of visual decision support tools in an interactive stakeholder analysis-old ports as new magnets for creative urban development	2013
(Evers et al., 2012)	Collaborative modelling for active involvement of stakeholders in urban flood risk management	2012
(Cashman, 2011)	Case study of institutional and social responses to flooding: Reforming for resilience?	2011

The identified articles were read in their entirety to identify the urban resilience initiatives mentioned. Within the same document, it was indeed often possible to find information pertaining to different initiatives, distinguished for example by being set in different cities or having different purposes. Ultimately, the dataset subject of the analyses presented in this paper consists of a set of 57 urban resilience initiatives. In order to find useful information to address the research questions, the dataset obtained was subjected to inductive-deductive content analysis.

Content analysis is a methodological tool for textual data analysis, aimed at identifying manifest and/or latent meanings within texts, widely used for the analysis of business and management literature (Gaur & Kumar, 2018). In the study, to address RQ-1, the authors inductively identified the types of threats that the initiatives aspired to address. In parallel, again in the context of RQ-1, the authors used the dimensions and objectives of the City Resilience Framework (ARUP, 2014) to characterise the identified initiatives. The City Resilience Framework is one of the major frameworks for urban resilience and is composed of four dimensions (namely Health and wellbeing, Economy and society,

Infrastructure and Environment, Leadership and strategy) which group 12 goals (see Table 3).

Table 3: Dimensions and goals composing the City Resilience Index, adapted from (ARUP, 2014)

Dimension	**Health and well-being**
Goal	1. Minimal human vulnerability The key to achieving a standard of living beyond mere survival is to minimize human vulnerabilities. Meeting basic needs such as food, water, sanitation, energy, and shelter is necessary to reach a basic level of wellbeing that can help individuals deal with unforeseen circumstances.
	2. Diverse livelihoods & employment Citizens need diverse livelihood opportunities and support mechanisms to respond proactively to changing conditions in their city while maintaining their wellbeing. Access to finance, skills training, and business support allows individuals to pursue various options to meet their basic needs and accumulate personal savings for their long-term development and survival during crises.
	3. Effective safeguards to human health & life Health systems are crucial for preventing illnesses and controlling disease spread on a daily basis, as well as protecting the population during emergencies. They include a range of practices and infrastructure that maintain public health and treat both chronic and acute health problems.
Dimension	**Economy and society**
Goal	4. Collective identity & mutual support Active communities that are properly supported by city governments and interconnected with each other play a key role in creating a city with a strong identity and culture from the bottom up. This fosters trust and support between individuals, communities, and the government, allowing them to face unforeseen circumstances together without resorting to civil unrest or violence.
	5. Comprehensive security & rule of law A transparent and ethical justice system is crucial for reducing and preventing crime and corruption in a city, as well as promoting citizenship and maintaining order during times of stress. Well-planned and resourced law enforcement also supports peaceful recovery and ensures a healthy population by reducing crime-related injuries, fatalities, and stress.
	6. Sustainable economy A strong economic system is crucial for sustaining the investment that a city needs to maintain its infrastructure and support its communities. It allows for the creation of contingency funds that both the private and public sectors can use to respond to emergencies and unforeseen events. This enables cities to adapt to changing economic conditions and pursue long-term prosperity.

Dimension	**Infrastructure and environment**
Goal	7. Reduced exposure & fragility Conserving environmental assets is crucial for preserving the natural protection that ecosystems provide to cities, such as coastal wetlands and upstream woodlands. Proper design and construction of infrastructure, including day-to-day structures and specific defences like flood barriers, is necessary for effective protection against severe conditions and preventing injury, damage, or loss.
	8. Effective provision of critical services Effective management of ecosystems and infrastructure is essential for maintaining their quality and performance. During times of stress, some of these services become crucial for urban functioning. Well-maintained systems can better handle abnormal demand and continue functioning. Good management practices enhance knowledge of system components, allowing for faster restoration of disrupted services by infrastructure managers.
	9. Reliable mobility & communications Reliable communications and mobility support daily connectivity between people and services, as well as fostering a positive environment for daily living and working. Additionally, they enable rapid mass evacuation and widespread communication during emergencies.
Dimension	**Leadership and strategy**
Goal	10. Effective leadership & management Effective leadership is crucial in promoting trust, unity, and a shared understanding of a city's direction. A committed city government that makes decisions based on evidence empowers a city to thrive and respond to unexpected events.
	11. Empowered stakeholders The provision of early warnings and access to education, information, and knowledge empowers individuals and communities, making them invaluable assets to a city during unexpected events. This enables them to take appropriate decisions and be better positioned to act, learn, and adapt.
	12. Integrated development planning Development plans and land use regulations help cities coordinate and control urban development and guide future investments. They ensure alignment of individual projects, address uncertainty, and create a framework for dealing with multidisciplinary issues.

Additionally, in order to answer RQ-2 and RQ-3 for each initiatives the authors inductively collected data about the involved stakeholder (e.g. NGOs, citizenship, local government) and the adopted engagement practice (e.g. public events, workshops, online platforms).

4 Results

The results largely contributed to addressing the research questions. In the present Section, results are presented and discussed: first, the identified knowledge base is introduced from a time and geography point of view; then, in order to address RQ-1, the results about threats, impacted resilience dimensions and pursued goals are provided; finally, with reference to RQ-2 and RQ-3, the profile of the involved stakeholders and the employed engagement practices are presented.

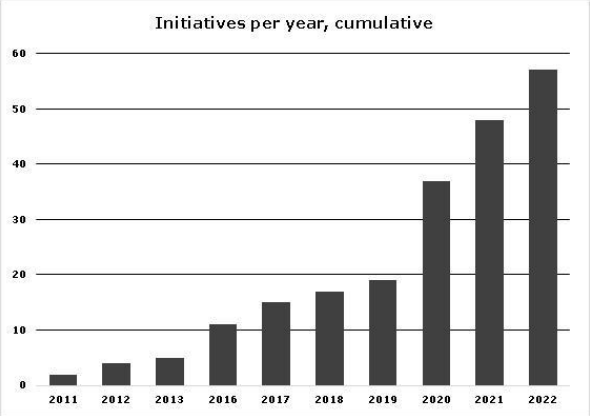

Figure 2: Number of initiatives included in the knowledge base per year, cumulated.

The identified knowledge base contains 57 initiatives, spanning a time period from 2011 to 2022 (Figure 1). Although the concepts of resilience and stakeholder may date back to earlier times (Freeman, 1984; Holling, 1973), no initiatives prior to 2011 were identified in the analysed literature. The trend in the time pattern of initiatives is increasing, with a surge in the last three years (2020-2022). This surge could be caused by the resilience challenges emerged during and following the Covid-19 pandemic crisis, a crisis also mentioned in some of the work identified (e.g. (Huynh et al., 2022)).

Geographically, the initiatives contained in the knowledge base are worldwide distributed, with a particular concentration in Europe. France, United Kingdom and Germany are the main settings for the identified initiatives, whereas developing countries are poorly represented within the knowledge base. Figure 2 shows that most initiatives have coastal and riverine towns and cities as their setting: most initiatives indeed deals with water management.



Figure 3: Localization of the identified initiatives.

4.1 Urban resilience initiatives: threats, dimensions and goals

The identified initiatives address threats related to different dimensions. In particular, a large part of the initiatives is aimed at preventing, coping with, adapting, or transforming the urban environment in relation to the threat posed by floods. Great attention also seems to be devoted to the threats posed by urban heat and the loss of biodiversity. In general, 72.6% of the initiatives included in the knowledge base address environmental threats (namely floods, urban heat, loss of biodiversity, stormwater mismanagement, water scarcity, sea level rise, air pollution, poor solid waste management, earthquakes, hurricanes, marine pollution, soil pollution, fires). Such a result contributes to demonstrating how the concept of resilience, although understood as multidimensional, is very much associated with the environmental sphere.

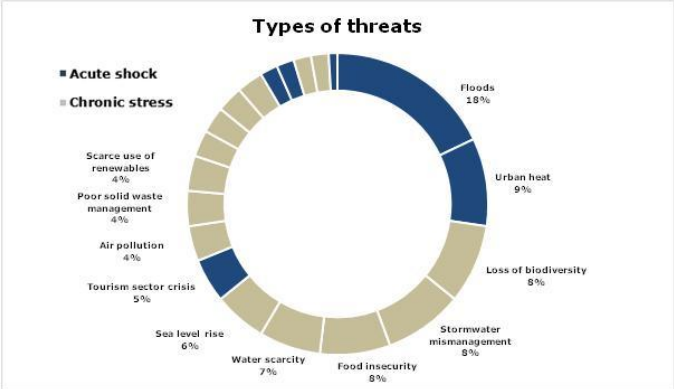

Figure 4: Pie chart representing the types of threats addressed by the selected initiatives and their frequency (percentage).

The identified threats can also be categorized based on the time of onset. Acute shocks refer to destructive and sharp events capable of causing significant damage in a very short time (e.g. earthquakes or hurricanes), while chronic stresses refer to threats that afflict the urban fabric constantly or cyclically over time (e.g. housing problems or public transport issues). From this point of view, the analyzed initiatives mainly deal with chronic stresses (63.2%). That suggests, limited to the knowledge base domain, an understanding of resilience that integrates long-term issues, so overcoming a conceptualization focused on coping (typically associated with acute shocks).

Water, one of main natural capital resources, is detected in 38.7% of the initiatives. The problem of environmental disasters caused by water can be traced back both to the effects of climate change and to the lack of planning for land management, protection and maintenance interventions, and prudent management of water resources (Olmstead, 2014). Therefore, it is considered as fundamental to establish plans aimed at an optimization and more rational management of water resources, also in function of the increase in world population (United Nations, 2015).

As described in Section 3, the initiatives were classified according to the dimensions and goals of the City Resilience Framework (ARUP, 2014). 42% of the initiatives is aimed at impacting the 'Leadership and strategy' dimension. With reference to the goals, 'Effective leadership & management' is the most pursued one, accounting for 18% of the initiatives, followed by 'Integrated development planning' (14%) and 'Empowered stakeholders' (11%). These values point to a trend towards inclusive governance involving government, business and civil society. Local governments are particularly engaged in the implementation of hazard monitoring and risk assessment processes as well as action planning to deal with slow and fast-onset events.

The low values pertaining the goals 'Reliable mobility & communications' (1%), 'Effective safeguards to human health & life' (1%) and 'Comprehensive security & rule of law' (2%) suggest an underrepresentation, within the knowledge base, of initiatives acting in the areas of transport, health and public safety.



Figure 5: Resilience dimensions, as defined in (ARUP, 2014) targeted by the identified initiatives, frequency.

4.2 Stakeholders and stakeholder engagement

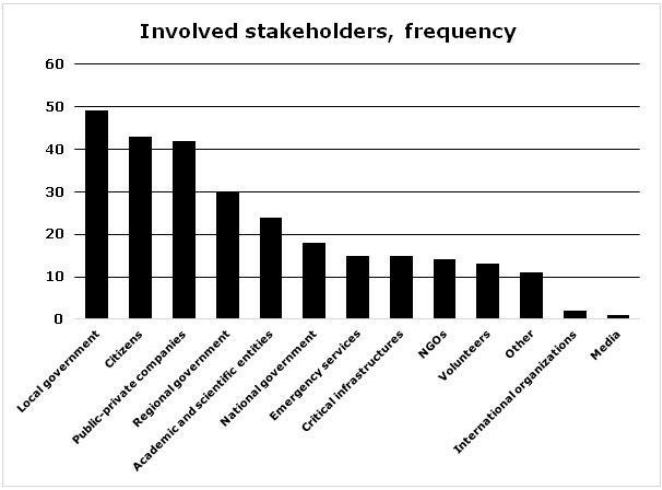

Figure 6: Stakeholders involved in the analysed initiatives and their frequency.

The analysis of the stakeholders involved revealed a significant presence of local governments (86%), citizens (75%) and public and private companies (74%), while central governments are present in only 32% of initiatives. It should be noted that the frequency of involvement of institutional stakeholders (local, regional and national governments) is positively correlated with the proximity of the institution to the territory. It suggests that resilience initiatives are generally promoted by local authorities that play an important role both in terms of

knowledge of the area and in raising awareness among other stakeholders. Nevertheless, a greater presence of the central governments, which could exercise a role of coordination and connection between various actors acting at local level, would be decisive for a more effective and coordinated use of the deployed economic resources.

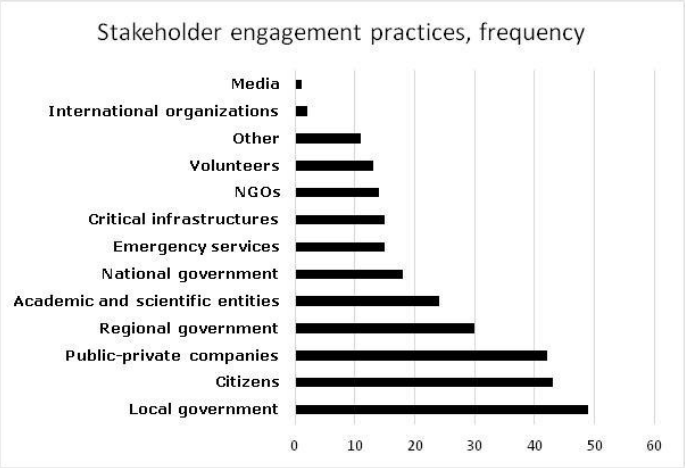

Figure 7: Stakeholder engagement practices adopted within the identified initiatives.

With regard to the stakeholder engagement practices, there is a widespread prevalence of community offline engagement tools, such as public events, interviews, and workshops. As shown in Figure 7, urban resilience initiatives are tentatively approaching the use of engagement practices that leverage new technologies. It is not surprising that these aspects have being highlighted by institutional stakeholders who advocate for the use of technological tools to make urban resilience initiatives more effective, attractive and recognizable (Adade & de Vries, 2023).

5 Conclusions

In the paper, a systematic literature analysis is adopted to explore the initiatives deployed to increase the resilience level of urban systems.

The study provides a map of interventions, so contributing to understand engagement dynamics underlying urban resilience initiatives. Results show that most initiatives are aimed at countering natural disasters or events that affect the environment. In particular, the frequency of events such as flooding, urban heat

and loss of biodiversity confirms that climate change is at the center of the international debate. An element of notable relevance is the conspicuous presence of initiatives aimed at water management both in terms of related disasters and scarcity, phenomena that can be attributed both to the effects of climate change and to the mismanagement of one of the most relevant natural resources. Such an aspect leads to reflections on the need to incentivize the planning of interventions for the management, protection and maintenance of the territory, as well as the prudent management of all resources, also based on the global demographic growth. The analysis highlights a significant presence of local governments among the involved stakeholders, so testifying the fact that initiatives are urged with a top-down approach. Local government plays a significant role both in risk assessment and in raising awareness of initiatives involving organizations, citizens and associations. A greater central government presence would favor the cooperation of international organizations and an effective and efficient use of economic resources.

In the study, the City Resilience Framework was used as a tool to rank the goals of the initiatives implemented, highlighting a trend, especially on the part of local governments, towards inclusive and participatory governance. Cities need new governance approaches that are inclusive, collaborative, reflective and with a long-term vision (Elmqvist et al., 2019; Webb et al., 2018). Governance rearrangements could facilitate the emergence of 'bottom-up' initiatives and give voice to citizens' needs so as to enhance the initiatives that deal with social aspects and stimulate planning processes to prevent disasters.

Future research directions involve the assessment of the discriminating factors in the choice of stakeholder engagement practices within urban resilience initiatives. Factors to be potentially investigated include available resources, expected outputs and the type of targeted stakeholder.

The study is not without limitations. Firstly, despite the development of a systematic literature analysis protocol aimed at answering the formulated research questions, it is not possible to ensure the inclusion of all papers relevant to the research. Furthermore, despite the fact that the content analysis phase was handled with a deductive approach which adopted the City Resilience Framework dimensions and goals as a priori set themes, it cannot be excluded that the results are susceptible to the sensitivity of the researchers involved.

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Communicating Circular Economy: Implications of Habermas's Theory of Communicative Action in the Public Sector

Elisabetta Pozzetto

Department of Economics, Management, Mathematics and Statistics "Bruno de Finetti"
University of Trieste
Piazzale Europa, 1 Trieste (Italy)

Abstract

The study applies Habermas' Theory of Communicative Action (TCA) to expand research on public sector communication about the Circular Economy (CE).
Theory guides the analysis of a case study of an Italian region ranked among the most advanced in terms of CE legislation. A qualitative study was conducted, with in-depth interviews with officials, communicators and information workers. The research is based on a narrative enquiry approach and uses guidelines to increase methodological accuracy.
The study is relevant from theoretical and practical perspectives. The conceptualisation of CE communication can provide analytical leverage and guide the operationalisation of social change programmes required by the CE paradigm, suggesting the benefits of incorporating the concept of interaction to promote circularity principles. From a practical point of view, the study identifies limitations and enabling factors of the current communication model and generates a set of indications that policymakers and communication/information professionals can use.
The study lies at the intersection between communication and CE and fills a gap in the literature, particularly in the public sector.

Keywords - Communication, Circular economy, public sector, Habermas's theory of communicative action, qualitative research

Paper type - Academic Research Paper

1 Introduction

Although the literature on the Circular Economy (CE) has been growing in recent years, the debate around its theoretical delimitation is still ongoing, affecting the effectiveness of its communication process.

Much of the research has also so far focused on investigating the implementation of the CE in the private sector, neglecting the public sector, which instead has both a tangible impact as it purchases, consumes and disposes of resources and services and, above all, serves as a role model for social and economic actors.

This study uses Habermas' Theory of Communicative Action (TCA) as an analytical framework to evaluate the state of communication of the CE by the public sector.

As the CE is a concept on which there is still no unambiguous definition, applying a theoretical framework that sees its core in communicative rationality, i.e. a form of reason oriented towards social interaction and the process of mutual understanding and negotiation of meaning, seems the most suitable.

On the one hand, communicative rationality provides a model for understanding the mechanisms of involvement and information sharing; on the other hand, Habermas' theoretical framework on language allows for guiding the exploration of the intent and purpose of communication in the public environment for the promotion of circularity.

It is possible to apply TCA in different ways in the context of communication and CE research. For instance, one can use the theory to study the communication dynamics between stakeholders, such as businesses, authorities and citizens, in promoting CE.

Furthermore, one can use TCA to develop effective communication strategies to promote CE by creating spaces for dialogue and participation to engage different stakeholders.

Finally, the theory of communicative action emphasises the importance of the active participation of citizens in the public sphere, which can foster the construction of a widespread consensus and the monitoring of public agency actions. In this sense, communicative action can foster a relationship of trust between the public body and citizens, promoting a culture of sustainability based on concrete actions and reinforcing the 'brand' of a public body understood as a capital of good reputation and reliability.

As a starting point, the study defines the concept of communication in the public sector and that of the CE.

The growing academic literature has proposed many definitions of CE (Geissdoerfer et al., 2017; Murray et al., 2015; Korhonen et al., 2018), and up to now, it has 114 different versions (Kirchherr et al., 2017). Still, in this paper, we refer to the most comprehensive and widely used one, developed by the Ellen MacArthur Foundation: "An industrial system that is restorative or regenerative by intention and design [that] replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impairs reuse and aims for the elimination of waste through the superior design of materials, products, systems, and within this, business models" (EMF, 2013, p.7).

This study aims to analyse the communication model of CE in the public sector from the perspective of Habermas' communication concept. In order to achieve this, the research adopts a qualitative approach with exploratory purposes, carried out through the collection of secondary data published in institutional sources and primary data obtained through in-depth interviews. In particular, the results of the research applied to the Lombardia Region, indicated by previous reports (CER, Energy&Strategy Group Politecnico, 2021) as the most advanced among Italian Regions in terms of CE legislation, are presented here as the first phase of a broader multi-case study.

After an overview of the main concepts of Habermas' theoretical system, this article will describe the context of the application, pointing out that the regional aspects of CE are still little studied, although they are a crucial dimension of the CE. In a later section, the paper will analyse the communicative components of the case study in light of the theoretical concepts. The rest of the paper will present the methodological approach adopted, a section with the main results of the in-depth interviews. Finally, results will present theoretical and practical implications, with an insight into the enabling factors, the research's limitations, and future perspectives on implementation.

2 Public Communication

This paper lies at the intersection of research in public communication and studies on implementing CE practices.

Theoretically, if understood as opposed to 'private' communication, public communication would be addressed to a more or less wide audience; thus, all mass communication would fall within the meaning of public communication.

In the literature, narrower meanings, which present both divergences and points of contact, have therefore come together: political, social, institutional, and general interest communication relating to the public sphere and communication relating to public administrations (Gadotti, 1993; Grandi, 2001; Rolando, 1995, 2001, 2004; Mancini, 2015; Rovinetti 2000, 2005, 2007; Faccioli, 2000; Nieto, 2006; Mele et al., 2011).

In this study, public communication refers to public administrations and authorities (La Spina, 2007, p. 2).

Often in the literature, the definition of communication by a public administration overlaps with that of 'institutional communication', even though the latter, on the one hand, is also referable to non-profit organisations, associations, and companies that are not public bodies and, on the other hand, the objective - to disseminate identity - does not exhaust the communication purposes of a public administration.

This study focuses on the communication activities of public administrations, particularly those organised on the initiative of regional administrations. The literature identified three types of communication within public administrations: internal, external - addressed to individuals and associated citizens -and external communication - addressed to the mass media (Faccioli, 2000). This research considers external communication.

According to Mancini (2015), who in turn borrowed Luhmann's (1984) model, it makes no sense to distinguish between communication and information, as communication always implies an informational activity, and this, in turn, requires a correct understanding, hence the creation of an effective channel between sender and receiver, so that it is decoded and used according to the sender's intentions. (Mancini, 2015, p. 100).

2.1 Communication of Circular Economy

Numerous studies have highlighted the importance of communication for disseminating the CE (Hunka et al., 2021; Vehmas et al., 2020; Sawe et al., 2021). In Europe, the New Action Plan for the CE (2020), compared to the one adopted in 2015, has placed more emphasis on the importance of information and has

challenged the private sector and the responsibility of national and local institutions to implement communication policies.

The Plan emphasises, in addition to ecodesign and sustainable design, the empowerment of consumers, who must be provided with reliable and relevant product information to make more sustainable choices. At the Italian level, the 'National Strategy for the Circular Economy' (Ministry of Ecological Transition, 2022) identifies actions, objectives and measures for defining institutional policies to ensure the transition to a CE. The Plan, starting from the conviction that the development of CE must concern both the improvement of production efficiency and the change of consumption models, identifies the need to intervene in consumer behaviour: to this end, it indicates the need for the development of a national environmental education and communication plan, locally declined, which, starting from compulsory schools and reaching families, contributes to forming a generation of critical, aware and informed citizens. Among the indicators for monitoring and evaluating circularity, the Strategy indicates communication campaigns on CE.

3 Analysis of communication from the perspective of the Theory of Communicative Action (TCA)

3.1 Introduction aspects

In order to analyse the external communication of the Regions applied to CE, this study deemed valid to adopt the perspective of TCA. Since its elaboration in 1981, TCA has proved to be fundamental for contributing to philosophy and social theory. Subsequently, numerous interdisciplinary studies have also drawn on its theoretical basis.

It has been used both in general, as a moral framework for organisational and public relations communication (Burkhart, 2007) and to analyse the characteristics of the ideal discourse in communication and evaluate participative communication (Jacobson and Storey, 2004), and in applied terms also in the corporate field (Herda and Messerschmitt, 1991), e.g. in the field of marketing methods (van Toledo, 1986) and brand management (Kernstock and Brexendorf, 2009).

Habermas's TCA perspective (1997) is applied here to analyse the relationship between the public body offering information and the external stakeholders receiving this information about CE principles, processes and initiatives.

In order to understand the nature, effectiveness and complexity of communicative action, it is necessary to indicate the framework in which it takes place. For this purpose, it is the category of the world itself that needs to be clarified. Habermas takes up the one elaborated by Popper (1979), who distinguished the objective world of facts, the social world of norms and the subjective world of individual experience. These three meanings, which correspond to the dimensions of culture, society and person, constitute Habermas's different but communicating levels of explicitness of communicative action in the contemporary age. The three dimensions occur against the backdrop of common sense, the culturally handed down background knowledge (Habermas, 1997, p. 725), constituting the life-world or vital world. Communication, the subject of the present study, is interpreted as coordinating the subjective and intersubjective worlds through dialogue and the sharing of meanings. The concept of the vital world thus becomes related to processes of understanding. Those who act communicatively integrate the three concepts of the world into a system and give, as intended, an interpretative framework that forms the background to the negotiation process to reach an understanding of a common meaning. Thus, communicative acting occurs within a vital world behind the communication participants. Based on this assumption, the consequences of the processes of social rationalisation and progressive reification of relations between people become manifest. Two strategies conflict: the 'system' and the 'vital world'.

Habermas identifies the reification of communicative relations as the cause of the 'colonisation' of the vital world typical in capitalist societies: the colonisation by the system over the vital world produces social pathologies. The reification occurs when subsystems of the Economy and state intervene with monetary and bureaucratic means in the symbolic reproduction of the life world.

Habermas expressly defines the 'green problems' as developments that blatantly undermine the organic foundations of the vital world and drastically bring to consciousness severe limits of the deprivation of basic aesthetic needs and sensibilities. The attack of large-scale industry on ecological balances, the scarcity of non-regenerative natural treasures and demographic developments present industrialised societies with major problems. Nevertheless, these

challenges are abstract and require technical and economical solutions that must again be planned globally and implemented with administrative instruments (Habermas, 1997, p. 1075).

In the particular area of public communication, understood here as issued by a public administration, it is also interesting to consider the concept of communicative rationality. The concept considers communication as the foundation of society and that human reason develops through communication.

In this case, it is a type of reasoning which aims to reach consensus through dialogue, a form of rationality oriented towards social interaction and the sharing of meanings. In other words, communication is a process that involves participants discussing 'validity claims' in order to achieve mutual understanding and reach a consensus. In the Habermas view, communication is a process in which each participant avoids egocentric calculations of success and control and engages in acts of understanding, continually negotiating over meaning to reach a common definition of reality.

Communicative action applies to a background and three validity claims: truth, correctness and sincerity or authenticity. In addition, there is an underlying, necessary claim: comprehensibility.

The philosopher then distinguishes communicative rationality from other forms of reasoning, such as instrumental rationality, based on the logic of calculation and power. Instrumental rationality seeks to achieve a result or objective using the available resources without considering the consequences for society or the environment.

Therefore, it is possible to escape the reifying rationalisation through communicative reason and not stifle the living world.

Analysing in the dynamics of public communication the presence and role of instrumental reason and communicative reason, the presence or absence of a disjunction between the system and the vital world, thus allows us to understand whether the transformation of communicative action into controlled interactions and the initiation of pathologies of the vital world is taking place.

3.2 Applying the TCA perspective to the Regions' external institutional communication on CE

Habermas' concept of TCA can be useful in understanding how external communication by a public institution can become a tool to promote the CE.

The CE is a complex paradigm which requires major behavioural changes and whose economic and social benefits are only sometimes immediately extruded (Korhonen et al., 2018; Daae et al., 2018; Bertassini et al., 2021). Communicative rationality is a tool to promote the CE, as it is a process based on finding consensus and cooperation between different actors. External communication of a public authority can play an important role in promoting the CE by sharing information on policies, programmes and initiatives.

A further concept from TCA regards the consideration of language as a central tool in constructing the social world and creating meaning. This idea is important in conceptually grounding the analysis of public agency communication that we propose here. Habermas (1997) argues that language has two main functions, the representative and the communicative.

The representational function refers to the way humans use language to describe reality and to give a representation of the world. Therefore, language's communicative function refers to language's ability to create consensus and facilitate cooperation between people. Habermas (1997) argues that communication occurs when participants in a linguistic interaction engage in mutual understanding and negotiation of meaning.

Furthermore, Habermas distinguishes between two types of language: action-oriented and life-oriented.

When analysing websites, press releases and other initiatives by a region, it is important to consider how language represents reality and creates meaning and facilitates cooperation and mutual understanding between participants in a language interaction. In particular, it is important to assess the type of language used, whether action-oriented or life-world-oriented, and whether or not the use of language contributes to consensus-building and facilitation of cooperation.

Life-world-oriented language refers to those discourses that aim to achieve intersubjective consensus based on mutual understanding and dialogue. On the other hand, system-oriented language refers to discourses that aim to achieve a specific goal, such as persuasion or political influence. In this case, language has an instrumental use; it serves to achieve a concrete result.

In CE, an example of life-oriented language could be a debate between experts to share knowledge and define shared solutions. On the other hand, an example of system-oriented language could be a press release that tries to convince the public of an authority's commitment to the CE without providing clear and verifiable information on their substantial impact.

An example of system-oriented language concerning the CE is the use of technical and bureaucratic terms that may need to be revised for the general public to understand and focus more on the economic and regulatory aspects of the CE. In addition, system-oriented language might emphasise mainly the institutional and legal aspects of the CE, without considering the involvement of stakeholders, such as citizens and businesses, in creating a culture of reuse and sustainability.

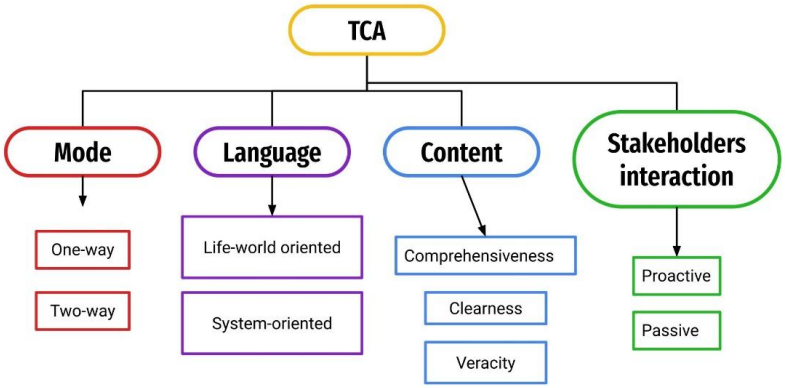

Figure 1. Personal adaptation from the TCA model

4 Application context and methodology

4.1 Application context: Regional administrations

In general, regional aspects of CE are still little studied (Dagilienė et al., 2021; Henrysson and Nuur, 2021; Scarpellini et al., 2019). The debate on how cities and regions should adopt CE strategies is ongoing (Sanchez Levoso et al., 2020). However, the literature agrees that regional issues are a key dimension of CE (Silvestri et al., 2020), and regions and their political institutions play a crucial role.

The Italian Regions are a significant example of how public policies can influence the adoption of CE practices. The Italian Constitution assigns them important competencies in various fields, including the environment and economic development. In particular, many Italian Regions have launched initiatives to promote the circular Economy, such as supporting enterprises that adopt circular business models, organising events to raise awareness among citizens and enterprises on the importance of the circular Economy, and promoting research and innovation projects. The Ministry for the Environment,

Land and Sea - General Department for Sustainable Development, through Sogesid, has monitored the Italian Regions also from the point of view of EC regulations with the project CReIAMO PA - Competences and Networks for Environmental Integration and Improvement of PA Organisations, and by re-elaborating data from the Circulary economy report drawn up by the Energy & Group of Strategy Politecnico di Milano (CER, 2021, p.116) has divided the regional administrations into three groups (Figure 2): "expectant", "work in progress" and under strengthening.

The "expectant" Regions have yet to create legislation that is capable of spanning various sectors; the "work in progress" Regions are in the phase of transition and of greater affirmation of CE principles within their legislation; regions "under strengthening" are those where CE principles are more pervasive and explore various sectors.

LAW'S PERVASIVENESS	EXPECTANT	WORK IN PROGRESS	UNDER STRENGTHENING
HIGH	Sardegna	Campania, Emilia-Romagna, Lazio, Sicilia, Liguria	Lombardia, Toscana, Veneto, Trentino Alto Adige, Valle d'Aosta, Friuli Venezia Giulia, Piemonte
MEDIUM	Abruzzo, Umbria	Marche	
LOW	Basilicata, Puglia, Molise, Calabria		

Figure 2. Classification of Italian Regions based on CE regulations system.
Source: Circular economy Report Politecnico 2021/CReIAMO PA

4.2 Methodology

From a methodological point of view, the present study was based on qualitative research with exploratory purposes, carried out through the collection of secondary data published on institutional sources and primary data obtained through in-depth interviews. In particular, the results deriving from the research applied to the Lombardia Region are presented here as the first phase of a broader multi-case study.[1]

[1] *Later in the research, all the regions involved in the CReIAMO PA project will be analysed to cover the whole country.*

4.2.1 Data collection

The criteria for selecting interviewees were role, i.e. covering administrative functions related to implementing circular economy initiatives, and operational relevance in communication processes. The study identified the first core of interviewees from the contact persons for the CE indicated as speakers at the conferences of the CReIAMO PA project by the regions themselves; from this initial group through a snowball sampling process (Noy, 2008), which envisaged the indication by each interviewee of other relevant potential interview candidates, 15 officials and managers were interviewed. Before the interviews, some pre-screening questions were administered to exclude irrelevant participants. The final group of 11 interviewees (Fig. 3) was formed when the materials began to show repetitive patterns, suggesting a saturation state. At this stage, documents were collected from public administration officials and available public sources as secondary data to provide a holistic understanding of the context. Using the Patton (2002) approach of the 'general interview guide', interviews were conducted by video conference or telephone between March and April 2023 and recorded with the participant's consent. The language used was Italian and the transcripts were then translated into English. They lasted between approximately 30 and 90 minutes each. Each respondent was assigned codes to refer to for quotes (e.g. A, B, C): this ensured anonymity.

SECTOR	SUBJECTS	FORMAT
Environment	1	Virtual conference
Economic development	2	Virtual conference
Sport	1	Phone interview
Foundation (subsidiary of Region)	1	Phone interview
Communication	4	Virtual conference, phone interview
Press office	1	Phone interview
Agriculture	1	Virtual conference
Total	11	

Figure 3. Personal elaboration

In order to answer the research question of what form of communication is adopted by the regions to disseminate CE, an inductive approach based on narrative enquiry was adopted (Pentland, 1999). The study considers it the most appropriate research method because it allows the collection of information from ordered sequences and the construction through the narratives of key interviewees of a coherent picture by identifying the mechanisms of content emergence, agenda setting, choice of channels and language.

4.2.2 Data Analysis

The process of analysis used is a thematic narrative, organised in five stages: 1) organisation and preparation of documentation, 2) emergence of a general sense of information, 3) coding process, 4) categorisation 5) interpretation.

The first phase started with transcribing the audio files, partly manually and partly through the sonix.ai software. All transcripts were reviewed manually to eliminate errors and non-narrative lines, such as random conversations. In the second phase, the narratives were re-read and recurring words and main ideas were highlighted.

In the next step, the data were coded manually. At the end of the coding of the first transcript, a code list was constructed; in subsequent transcripts, the codes from the list, when applicable, were extracted; conversely, new ones were created to be added to the main list. A final 43 codes were identified.

In the fourth stage, following the guidelines of Reissman (2008), the categories condensing the themes were identified. For this study, the codes were collected in two categories, the second of which was divided into five subcategories. The last step was the attribution of meaning to the data.

5 Results

In total, the data analysis identified 137 quotations and 43 codes. The codes were condensed into two main groups: respondents' perceptions and the communication model. The second category, i.e. the communication model, was subdivided into subcategories referring to applying the TCA (Mode, Language, Content, Stakeholder interaction, Transparency). Both categories made it possible to identify barriers and implementing factors for CE communication. Some quotations are given in Tables 6, 7, 8, and 9.

5.1 Barriers Limiting the Effectiveness of CE Communication

5.1.1 Confusion Sustainability/circularity

The interviewees mostly reported a personal definition of circular Economy that brings the concept under the broader category of 'sustainability', particularly limiting its application to the environment and waste management. Of the three dimensions - environmental, economic and social - almost only the first two seem relevant. This aspect reflects the great regulatory and financial commitment that the public authorities have deployed to create and spread circularity chains in the business fabric and to act with a significant quantitative impact on reducing landfill; on the other hand, however, it also reveals vast unexplored space to act on the dissemination of models that are inclusive of all the components of circularity.

5.1.2 Perceived lack of appeal of the CE concept

In addition to an objective quantitative scarcity of news (press releases, videos, social media posts) dedicated by the information component to the CE detected in the secondary data, the interviewees negatively perceive the topic's attractive potential. Some interviewees highlighted its elitist, 'niche' character, which contradicts the consideration of a rather informed and aware public and the belief that the target audience of young people is receptive and curious.

5.1.3 Attention Capture Time/Topic Complexity Ratio

According to a good number of communicators and information workers, the topic is difficult to understand at a time when the average person today is willing to hold their attention. The public's habituation to slogans borrowed from marketing and commercial communication, examples of greenwashing, has further deprived society of charge of the topic. Only some are willing to spend the cognitive energy and time to understand the paradigm shift and the disruptive effects of the CE. One interviewee stated: 'The discourse on CE is a subject on which there is a need for time and willingness to pay attention on the part of the recipient: you cannot get into it by dint of slogans. There is a need for opportunities to meet to make people understand that certain issues have dignity and value and that they cannot be slipped away in an advertising slogan' (F). This aspect is consistent with the TCA.

5.1.4 Technical Culture in PA Management

There is a prevailing opinion among communicators and informants that many important circular economy initiatives do not emerge in the storytelling of the public administration because the core of the actions and initiatives is the responsibility of every technical Department, which are attentive to the concretisation of results but do not consider the communication aspect as incisive for public policy purposes.

5.1.5 Lack of early communication activation

Technicians only sometimes activate communication experts in the preliminary stages of discussion tables and projects. This lack hampers the emergence of important content, the definition of clear communication objectives and targets, and a careful form of 'life-oriented' language.

Very virtuous cases have emerged in the case study - for example, the communication model applied by the Fondazione Lombardia per l'Ambiente, which was set up by the Region as a meeting point between the political and scientific worlds and whose mission is precise 'science for policy' - or communication campaigns on specific topics - the fight against food waste - where activation was immediate and very fruitful, but the situation is not generalised.

5.2 Enabling factors

5.2.1 Focus on CE

An organisational structure dedicated solely to dealing with the CE, acting as a collector and coordinator of all policies, and creating a dedicated management unit in the organisation chart represents a strong communication implementation factor. In the case study analysed, the establishment of a CE Observatory and an organisational unit dealing exclusively with CE, separate from the one dedicated to 'Sustainability', expresses a desire to mark the difference and show the uniqueness of the circular model. We are strongly aware that we should aim to promote all its dimensions.

5.2.2 Measurement and Evaluation

There is a clear awareness that measuring communication actions is fundamental, all the more so for public authority. While this is a well-established

practice on the part of the communication structures that manage social media, the rest of the interviewees point out that there still needs to be more committed to this, albeit very important, aspect.

5.2.3 Target Segmentation

One of the major challenges that communicators have identified as necessary to get the circular message across is a policy that dares to identify precise, verticalised targets. Among those deemed strategic for disseminating circularity are young people, who are already curious about the concept and considered 'ambassadors' to their families and environments. This factor is consistent with the National Strategy for the CE and the Environmental Education and Communication Plan.

5.2.4 Emotional Message

There is no doubt on the part of both officials and information workers that resorting to normative messages or appealing to emergencies to produce behavioural changes required by the circular model on businesses and citizens is ineffective and, indeed, very often counterproductive. Experimentation with communication campaigns that have resorted to emotional messages, albeit based on in-depth information and quantitative scientific studies, has yielded good results in engagement.

5.2.5 Interaction with Stakeholders in Attendance

Consistent with the theory of communicative action, strong stakeholder involvement in both the policy-making and communication phases is one of the most enabling factors. Many interviewees emphasised that the organisation of in-person events, participation in trade fairs, and public presentations are valuable ways of cultivating dialogue and reaping the benefits of two-way communication.

Table 6: Barriers limiting the effectiveness of CE communication – first category – Opinion

Fusion of CE in the sustainability concept	"I consider CE as one of the pillars of sustainability" (A) "During the 'Sustainability Forum' wide space is for CE issues" (B) "The Region (...) has equipped itself with the tool of the Sustainability protocol to create an important community around the topic, with a focus also on the CE" (G)
Environment predominance	"CE is one of the engines that must be started to achieve sustainability, first of all environmental, but also social" (A)

Economic predominance	"Towards a CE in response to new economic and energy needs" (A)
CE model in the making	"The world of CE is still a reality in the making, often to be created" (A) "Start-ups with circular models are catching on, but we are still at the very beginning" (A)
Limited CE concept	"It is the theme that deals with prevention and reuse and what we consider waste, which becomes second raw material ... It is associated with the concept of waste, in which there is everything" (B) "For me, CE means making the most of waste and, above all, trying not to produce it and to re-introducing it into a production cycle in an economically sustainable way and on a large scale" (C) "I have in mind a virtuous process that allows a 360-degree look at everything related to the environment, and that can benefit citizens. I tend to link it to activities of the Environment Department" (H)
Regulatory contradictions Complexity	"There are often contradictions between recycling and reuse" (G) "CE issue needs time and willingness to pay attention: one cannot enter into it by force of slogans. There is a need for opportunities to meet in order to make people understand that certain topics have dignity and value and that they cannot be slipped away in an advertising slogan" (F)
Time/Attentiveness	"Culture is done not by slogans but by devoting time and energy, by paying attention to those who ask you to account for your initiatives, why you participate in a UE project that implies a certain kind of use of public resources" (F) "Slogans dominate the world of environmental communication and are not interested in understanding who is on the other side, what they think, what they have understood, and how they can react" (F)
Technocratic culture	"Very technical departments, with a high number of engineering professionals, lack communication skills" (B) "Our utmost concern as technicians is to communicate to institutional bodies, e.g. the Ministry" (C)
Communication delegated	"We have communicated the circular supply chain call to the companies together with Unioncamere, which has concretely taken care of disseminating the information" (A) "The technical table "Plastic" of the CE Observatory relied heavily on the communication aspect of the European project structure" (C) "We made the call for the reuse centers known to the municipalities and those financed were obliged to publicise the initiative. We relied on the communication of the municipalities because it was more incisive at the local level" (C)

Delay in Involvement Communication	"I know it exists, but I have never attended a CE Observatory" (B) "There is a bit of a lag in the involvement of the communication sector from the early design stages of public policies, in general" (B) "When an initiative is born with the early involvement of the communication sector, it always takes on a clearer identity. Conversely, it remains vague; you struggle to make an impact (B) "On the communication of the ReCycling project we are we are only at the beginning" (H) "Communication involvement depends on the topic we are dealing with. We should certainly be present right from the embryonic part of the projects, and for example, we should follow all the stages of the CE Observatory, but there, for example, we are present a little bit on the side. On other topics such as the Sustainability Forum, on the other hand, we are involved from the earliest stages" (I)
What matters is the doing	"In my opinion, communication has taken a bit of a back seat. It was certainly disseminated among those who put the lines into practice, but it was limited to that" (C) "The technical component of the administration is concerned with involving stakeholders, making policies concrete, but then the whole part that is to disseminate all this work is missing" (C)
Elitist-niche concept	"Often, many actions and experiences are very elitist. For example, at the Ecomondo trade fair, I attended a talk by large luxury brands about the recovering service. A commendable initiative of commitment to circularity, but how many people can afford it? Perhaps these are examples that tend to make 'culture', but in my opinion, CE actions must be more within reach of the citizen, and there must also be a real relevance and economic return in supporting them on the part of the public sector" (C) "It seems that the circular economy is still perceived as being quite remote from the citizens, a very niche thing" (M)
Poor newsworthiness	"In a year of news published on the Lombardy News website, there is a very low percentage of news on the circular economy, perhaps 1 per cent. The editor asks very little about it" (M)
Unattractive concept	"It is not a theme considered particularly attractive" (B) "There is no strong demand for information as on other topics" (B) 'These are still issues that do not warm the heart' (C) "In my experience, it is not a topic of strong appeal, and there is little engagement" (M)

Table 7: Enabling effectiveness factors – first category – Opinion

CE as a distinct concept from sustainability	"We have two organisational units, one dealing with sustainability and one with CE" (B) "The CE is one of the communication focuses on which we have decided to keep a spotlight at all times" (F)
Extension of the concept	"The CE Observatory follows two sectors in particular, waste and energy. The waste component has thematic tables on plastics, aggregates, steelworks and foundry slag, sludge, food, and non-recoverable waste. We plan to activate one on textiles soon" (C) "On the one hand, the Region has indeed focused essentially on minimal landfilling, but I think it is a path that has begun and aims to achieve all the 'R's of the circular model one step at a time. It takes time, but the first steps have already been taken" (E)
Early involvement communication	"The National Waste Plan provides to reduce food waste. Among the actions identified are communication campaigns, which were considered important in the study's results commissioned by the university and in other literature. Our structure is technical, and we asked for collaboration with the communication staff of the Environment Department and the General Department" (D) "Communication is part of the project, not an optional aspect, precisely because the aim of the Foundation is the transfer of knowledge" (E)
The propensity for communicative innovation	"There are not many situations in which the campaigns go off the track of the institutional standard, but on this aspect, the Presidency of the Region has good attention and willingness to set out on new paths" (B) "We need to get to work on the site because there is much information, but it is scattered here and there and often difficult to find: we now have the idea of creating a page where we can collect all the prevention actions, correlating them with the results of studies, campaigns, and also 'showcase' what has been done not only by us as a Region but also by organisations and associations". (D) "We are developing a digital storytelling platform that will also be open to stakeholders where communication campaigns can be shared. We want to tell how they are created and upload the data" (G) "Region is trying to innovate a lot on the communication side, which from an overall point of view is already good" (I)
Emotional mood	"In promoting certain circularity actions, it becomes important to use emotional messages" (B) "The campaign against food waste played on the concept of 'loving' and therefore not throwing something away" (B) "The concept of a love affair with food is an emotional communication choice; the choice of influencers was also" (G) "We made an emotional video that followed the volunteers of an association on a typical day both to promote activities but also to make people understand how we have important impacts against waste" (G)

Cross-sectoral vision	"The CE Observatory is a table for comparing and sharing objectives with all players in the area" (A) "The CE Observatory is organised in coordination tables" (A) "We are not the only directorate dealing with CE because it is an issue that needs to be addressed in the round" (C) "For us, the CE is a cross-cutting policy in respect of which we have activated an initial communication and awareness-raising work concerning the campaign against food waste" (G)
Sharing with stakeholders	"The CE Observatory defines the expected results of the joint construction process of regional environmental and climate policies and strategies" (A) "Institutions, organisations, and experts are invited to the tables of CE Observatory" (A) "Collaborative agreement with universities to promote CE transition based on reconditioning and recycling of existing materials and products, extending their life cycle as far as possible and minimising waste" (A) "Close cooperation with companies and stakeholders in the waste management chain and with citizens. Obviously, there is no good waste collection without the cooperation of citizens" (B) "To share policy choices on CE, an Observatory has existed for years, bringing together regional leaders and stakeholders" (B) "We interface with actors who then put CE policies into practice, so certainly trade associations, consortia, environmental and consumer associations, and then it is very important that there are researchers at the tables, so we involve the universities" (C) 'When we set up the thematic tables on CE, we launched an initial expression of interest through the Region's channels and so interesting parties were able to apply to participate" (C) "At the steelworks slag table, a precise proposal came from the trade associations to find common guidelines for disposal" (C) "We are very open to proposals that come to us from operators, and we never set out to do anything at all" (C) "The councilor for the Environment in the legislature that has just ended strongly wanted a CE Observatory, and in the table against food waste, all the actors involved (non-profit organisations, research organisations, environmental associations, representatives of the large-scale retail trade) participate, with whom all actions have been shared, including the communication campaign" (D) "In the table against food waste, we created a sub-table communication and in addition to suggesting the most important contents, many actors, such as non-profit organisations, expressed their willingness to make themselves known, and the communication campaign took this into account" (D) "The Region has an active table on regional policies 'Development Pact' at which various stakeholders sit, almost all the association acronyms, in which we have created a sub-table dedicated to communication to identify and share joint communication lines, which could act as a sounding board for regional activities but also deserving ones coming from the territory" (G)

	"Communication towards the stakeholder is the driving force behind all our actions". (I)
Time-tested involvement	"Regione Lombardia has been investing in CE and sustainability issues for years now" (A) "The call for CE supply chains is now a tried and tested instrument" (A) "For several years, the region has developed separate collection and re-use policies, such that it has excellent indicators even compared to European best practices in this area" (B) "In the 20 years that I have been dealing with waste in Regione Lombardia, in many respects, the approach has changed enormously" (C)
Proudness and awareness of results	"Around forty companies participated in the call for CE supply chains with very interesting initiatives" (A) "Last year, in 2022, 50 percent of the funding dedicated to the CE by the Region went to the Economic Development Department." "The investment of Lombardia's entrepreneurs in green is a given compared to other areas of the country" (B) "We are the second largest directorate (Environment) for investments in communication in Regione Lombardia: this is because we believe that environmental issues as a whole and the effects of the CE are the times not of the future but of today" (I)

Table 8: Barriers limiting effectiveness-2nd category - Communication method

Language- System oriented	"Public administration is aseptic, it tells in a detached way. There is a problem with the public communication of emotions: yet there would be issues that could be profitably dealt with using an emotional mode and this would touch the interlocutor better" (B)
Mode - One way	"We have communicated the calls to companies through the Region's website and the dedicated section Sustainability in Lombardia" (A) "In general, in Regione Lombardia, we are not used to thinking of communication as listening, which is fundamental" (B) "The work of the technical tables is published on the sustainable development online platform. This section is not always updated in real-time, but we try to keep up with it. Perhaps the platform does not give an organic view of the work of the CE Observatory" (C)
Transparency low	"As a citizen as well as an official, I think there is still some effort to be made" (B) "On data that are a systematic source of difficulties in public management we do what the law prescribes, no more. In short, we keep silent profiles on certain topics" (B) "The world of environmental communication is dominated by slogans and is not interested in understanding who is on the other side, what they think, what they have understood and how they can react" (F)

Discourse - System-oriented	"We need a policy that says about the CE more clearly: look we are doing this and this and this, public money is being put here and taken away there because this choice serves us all better. I am communicating a choice that is an attribution of value" (F) "Remove the compulsion to announce politics that the media world feeds tremendously" (F) "Information should be useful but sometimes there is a quota of somewhat empty press releases. But for 85 percent, they are all of the substance' (M) "Sustainability, CE, environment are words emptied of meaning by marketing communication" (F)

Table 9: Enabling effectiveness factors - 2nd category - Communication method

Mode - Two-way	"The Sustainability Forum was an opportunity to disseminate initiatives and is open to all" (A) "The two-way interlocution is honestly sporadic and occasional, but there is a plan to move in that direction precisely because the topic of CE is not so attractive in itself" (B) "Our relationship with our stakeholders is not one of supplier-customer as much as a partnership, and even in communication, we try to set it up as one of participation and inclusion" (E) "We know that the most genuine dynamic of education is the one-to-one relationship, and it is a sowing that is worthwhile regardless of the numbers it can bring" (F) "Organising in-presence events such as the Environmental Education Fair or the Rimini Meeting is crucial because they always have the dimension of listening and meeting the target audience of our communication actions" (F) "The influencer we involved also relies heavily on relationships with her followers, which she translates into in-attendance moments where she often meets her audience: she has managed to engage with a large audience on the issue of waste and has fuelled a lively discussion"(G) "We planned a public presentation event during the Sustainability Forum where the moderator engaged the audience to participate" (G) "The communication of the ReCycling project will not so much be through social media as through the organisation of events in the various partner territories: we try to create a network of public administrations that already have reuse centers, stakeholders, associations and to organise events where young people can participate together with a wider public that may be interested in bringing their bike and exchange it" (H)

Language - Life world oriented	"On the Waste Plan, which among other things provides policy guidelines for waste prevention, reuse, and recovery, a so-called 'pop-up booklet' has been produced, which is intended to be a simplification of data and information" (B) "I have a personal aversion to institutional and formal language" (B) "Political and scientific worlds are two very different worlds in terms of language, and the added value of the Foundation is precisely to work on academic, specific topics and make them understandable and communicable" (E) "We try to bring the scientific content to as accessible a formula as possible, without distorting it, without trivializing it" (F) "Language is relative to the medium and the target and is continuously modulated" (G) "I personally, when I write a news story, I aim to make anyone understand any topic, even very technical and vertical ones" (M)
Transparency	"An easily searchable database for citizens on all waste facilities in Lombardia, with geo-referenced maps, will soon be online (B) "If we are the project promoter, we usually make the data open access, but if we are commissioned, we only communicate the general data, and the decision on the complete data remains with the client" (E) "Since working with the Foundation, I have worked on re-designing the site to access content more easily and more immediately."
Content-based on veracity	"The Foundation is the place where policy and academia physically meet, and the mission is 'science for policy, the process by which information is transferred from the scientific community or individual researchers to policymakers, to produce evidence-informed policies" (E) "For the reduction of food waste, a study was commissioned to Università Cattolica in collaboration with the Fondazione Lombardia per l'Ambiente, which has expressed an environmental, social, and economic assessment of the benefits of waste reduction" (D) "The study carried out by Cattolica, 'Virtuous networks against food waste', showed how important it is to intervene also on communication to citizens to reduce waste at household level" (D) "Almost all areas of environmental communication are inflated, many concepts are empty words, or totems of commercial communication permeated with greenwashing: we need to restore scientific rigor to what we disseminate" (F)
Content clearness	"We have always used content with positivity-focused messages" (D) "For how many years have we been fed messages of catastrophism? We have become addicted to bad news, and they have no effect" (F) "The campaign created engagement because it succeeded in touching common points, moving away from the logic of the decalogue, which was there, but empathising with the suggestion of everyday domestic tricks" (G) "Emergency communication is very dangerous, and we realised this with Covid. You have to know how to manage it; otherwise, it does more harm than good" (M)

Stakeholders interaction-knowledge transfer	"Foundation acts as a bridge between politics and science to enable knowledge transfer" (E) "We work on a practical level with schools, with teachers and pupils, going into classrooms, organising events or training courses, and developing teaching tools that we offer free of charge, and the topic of the circular economy is one of the most in-depth and developed for schools" (E)
Stakeholders interaction-training	"Tying in with the theme of communication, we develop tools on the topic of the circular economy for schools of all levels" (E) "We activate a mix of communication, education, and training to spread environmental and circular economy culture" (F)
Channels	"The chosen channel for the campaign against food waste was exclusively social media because everyone is now communicating this way, and we asked four influencers with different personal follower bases to participate" (D) "The first channel we use for CE news is digital, website, and social networks (Facebook, Youtube, and Linkedin). The second channel is the editorial one and the latest tool we are making available free of charge to schools and citizens are dedicated to the circular economy and are called 'The world is a wheel'" (F) "We use video a lot because we also operate in the big attention market where the real challenge is an irrelevance, and therefore, we look for an issue like the circular economy to deserve the attention and consideration it deserves" (F) "Instagram is our main channel, but we also use Linkedin to narrate the communication operation. In the case of the campaign against food waste, we also used posters in the main railway stations during Christmas' (G)
Target segmentation	"The target group of the campaign against food waste was exclusively citizens" (D) "The information level of the average citizen on circularity issues from our observatory is quite at a good level" (E) "The topic is one that young people can get involved with" (E) "One of the big challenges is to study and understand the target audience well, whom we are talking to, to identify them and 'lose' time in studying, getting to know the people we are addressing" (F) "Last year, we stayed on broad targets for the food waste campaign, but this year we are developing a campaign on a specific target, in particular middle schools, because during the working table meetings, we were very emphatic about the educational objective, so we are now verticalising on schools" (G) "We need to focus on target groups. Focusing on children is the right way to go: they are future decision-makers and potential educators in their families and environments. They are ambassadors" (G)

6 Discussion

The results suggest that the organisational structure and the public authority's communication model influence how information and content related to the CE are transferred externally. A model derived from the qualitative analysis summarising the main enabling factors is proposed in Figure 10.

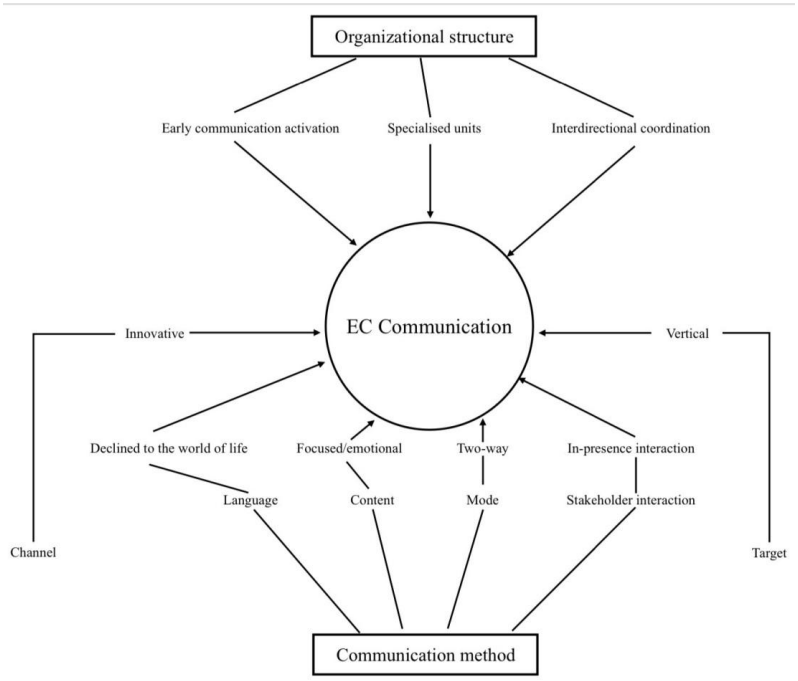

Figure 10. Enabling factors CE Communication: insights from qualitative analysis.

7 Conclusions

The study presents the research results applied to the Lombardia Region as the first phase of a larger multi-case study examining representative regions throughout Italy. However, this research has many limitations, which can represent a starting point for investigating the topic in greater depth. Future studies could analyse the differences between public communication strategies and those adopted by the private sector and include the view of stakeholders.

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Rethinking the Means to Achieve Organizational Efficiency in the Italian Judicial System: A System Thinking Approach

Arianna Ciabattoni*

Department of Management
University of Turin
C.so Unione Sovietica, 218/bis, 10134, Turin, Italy

Stefano Armenia

Department of Management
University of Turin
C.so Unione Sovietica, 218/bis, 10134, Turin, Italy

Francesca Ricciardi

Department of Management
University of Turin
C.so Unione Sovietica, 218/bis, 10134, Turin, Italy

** Corresponding author*

Abstract

In this study, we focus on the modeling of the judicial system through a suite of System Dynamics. More specifically, employing a participatory modeling approach (GMB – Group Model Building) based on the System Thinking methodology, we have developed Causal Loop Diagrams, which we have then transformed into quantitative models through the modeling and simulation methodology known as System dynamics. The System Dynamics approach allows the development of context and scenario analysis aimed at identifying bottlenecks and high-leverage strategies for improving the judicial system's performance.
We carried out 50 interviews and 200 hours of participatory observation in shadowing the human resources working within the Italian courts, and the present paper relates to our main findings.

Keywords – Judicial System, Public Management, System Thinking, Organizational Behavior, Innovation Studies.

Paper type – Academic Research Paper

1 Introduction

In Italy, no structural reforms have been carried out in the organization of the work of judges. However, with the approval of the National Recovery and Resilience Plan (PNRR), the Italian Ministry of Justice has committed to the European Commission to achieve specific targets, with particular reference to the reduction of the disposition time (DT) and of over-three-year civil judicial backlog, following the principle of a reasonable duration of the trial. The objectives of the Project "*Next Generation UPP: New collaborative schemes between Universities and Courts to improve the efficiency and performance of the judicial system in North-West Italy*" represent a major organizational challenge.

In this context, it appears clear how the reduction of the judicial backlog of cases in first-instance or second-instance Courts is a critical aspect that demands immediate attention from Policy Makers to guarantee efficient work of the involved judicial organizations and thus also reflecting in an effective result in terms of the reduction of the average disposition (processing) time of each judicial case and hence in terms of the general "lead time" offered to citizens. Each Court thus has the problem of guaranteeing a proper lead time in working out each case (either first instance or second instance appeals), hence minimizing its Clearance Rate (meaning the rate at which courts can process and finalize their backlog of cases)

2 The Modernization of public organizations and the New Public Management (NPM)

In the 1990s, the same innovative logic guided, with the adaptations required by the specificities of individual countries, the administrative reform programs launched first in the United Kingdom, then in the USA and northern European countries, in Germany, and finally, in recent years, also in France and Italy. The public sector modernization process started in the context of the financial crisis and was mainly driven by the need to reduce the costs of public administration and services.

However, the awareness that cost containment was a focus also accompanied by a crucial objective: improving the quality of public administrations' services.

The issues of the quality of public services and the central role of the customer, as a strategic resource for assessing the correspondence of the services provided

to the actual needs perceived by the users, thus assumed considerable importance.

A new organizational culture emerged oriented above all to disengage the public administration from the characterizing legalistic-formal vision for adopting a management logic based on achieving the result.

This global dimension process was denominated New Public Management (NPM), highlighting the conjunction between the public character of organizations and the business inspiration of management techniques. At the basis of NPM is Ronald Reagan's famous ideological statement was posed: "*Government is not the solution to our problem, the government is the problem*."

The NPM is an approach mainly focused on transforming public management to facilitate more effective measurability and evaluation of performance for the final objective of reducing public spending. This new conception introduces tools, principles, and dynamics of private management.

The effort is, therefore, to implement the modernization of the State and its institutions by basing it on methods and techniques typical of the organizational and management sciences, however, considering the peculiarities of the public macrostructure oriented towards pursuing public scopes.

The fundamental principles of this new theoretical approach are generally traced back to the decentralization of functions and authority from the State to local government centers, to the introduction of competitive logic in the production and management of public services, to the privatization of public companies, and to a greater orientation to the result.

In this basic perspective, the work by D. Osborne and T. Gaebler, "*Reinventing Government. How the Entrepreneurial Spirit is Transforming the Public Sector*", constitutes the starting point: the inspiring idea of this perspective contrasts with the Weberian model and focuses on the results that could be achieved if public managers were allowed to operate with a flexible approach driven by missions rather than rules that pursue results by meeting the needs of the customer, not the bureaucracy[1]. As noted by Hague and Harrop, the NPM marks the shift from public-sector administration to public-sector management:

1 Osborne and Gaebler's "Reinventing Government" outlines ten principles that authorities should adopt to foster their effectiveness: a) promote competition between service providers; b) empower citizens by pushing control out of the bureaucracy into the community; c) measure performance, focusing not on inputs but on outcomes; d) be driven by goals, not rules and regulations; e) redefine clients as customers and offer them choices – between schools, between training programs, between housing options; f) prevent problems before they emerge, rather than offering services afterward; g) earn money rather than simply spend it; h) decentralize authority and embrace participatory

> *"…The significance of this, in turn, is the break it represents with Weber's view that the job of a bureaucrat is simply to apply fixed rules to cases. For its supporters, NPM is public administration for the twenty-first century; Weber's model is dismissed as history. Public administration has been displaced by public management".*

Therefore, the modernization of the public administration becomes of fundamental importance since an efficient administration and tangible progress in the services provided to the community and businesses directly influence a country's economic development. In essence, it is a matter of redesigning the administrative structure of the State, improving its product, eliminating useless procedures, simplifying the necessary ones, and reducing responsibilities and burdens.

2.1 From New Public Management to System Governance

New analytical perspectives began to emerge between the end of the 90s and the beginning of the new century, which opened under the sign of public policies conditioned by the need to contain public sector expenditure and rationalize the costs of public institutions (Borgonovi *et al.*, 2017). In the context of the international economic crisis and the subsequent austerity policies, some critical issues of the New Public Management were starting to be highlighted. Among these, the debate focused on the tendency of the NPM to propose a mechanistic model, unable to highlight the managerial and decision-making specificities of public administration. The main limitation of the NPM lies in wanting to transfer the logic of the world of private companies to the public sector in an almost automatic and uncritical way[1].

Secondly, the rationale for founding the NPM would not be *a priori* applicable to all public services provided by public administrations. In fact, for some of these, it was easier to transfer tools and dynamics of the private sector[2]. In contrast, for

management; i) prefer market mechanisms to bureaucratic ones; j) catalyze all sectors – public, private and voluntary – into solving community problems.

1 Among the further limitations of the NPM, there is also the tendency to underestimate ethics, fairness, and democratic principles, neglecting the specificities of the public administration understood as a subject that provides public services, in the implementation of the interests of the community. The emphasis is also placed on the further propensity of the NPM to lose sight of the inter-organizational and relational perspectives within public institutions, neglecting the cultural, socio-political, and managerial differences of the different local contexts.

[2] For example, telecommunication, public transport, and distribution of water and electricity, etc.

other more complex and articulated sectors, this was only partially successful, or it was not possible[1].

Therefore, in recent years, the NPM has gone through a new phase, namely that of implementing its theories, generally united by the focus on the characteristics of the internal and external environment, and preparatory to changing the face of the public administration.

This is System Governance or Public Governance, which is based on the policies of globalization and European integration, aimed at constructing new relational models, both at an institutional and governmental level, to guide public policies toward pursuing common and shared goals.

More specifically, public agencies are required to adopt governance policies that, considering the variables that influence the social, economic, and administrative system of a given reality, can create value for the community, ensuring that every action is carried out in compliance with the principles of economy and efficiency. Public operators must therefore ensure the quality of each initiative and encourage customers' cooperation in satisfying the community's needs (Bracci *et al.*, 2019).

The governance wave was therefore born as a response to the weakening of the State[2] and intends to represent a new technique for taking care of the common interest through the coordination and involvement of all stakeholders in the process of redistribution of decision-making power. In fact, regarding the tools used to realize this redistribution, self-organization is favored by implementing reticular and horizontal organizational structures characterized by collaborative rather than hierarchical relationships. These structures are based on maximum informality and the search for the engagement of all stakeholders in elaborating and implementing decisions (Ansell and Torfing, 2021).

In this sense, we understand how the accountability of public operators towards the community assumes an increasingly important role, following the criteria of participation, efficiency, and transparency in the management of public financial resources and in the activities and results the public administration achieves. The accountability-governance combination is, in fact, synonymous with a radical change that has affected the public sector, that is, the transition from a model of authority based on the rigid, formal, and hierarchical distribution of

[1] *Health and education systems are the best-known cases.*

[2] *Precisely, the centralized nation-state model is unable to develop a differentiated solution for the variegated needs of the reference communities.*

powers and responsibilities to a governance approach inspired by the principle of subsidiarity which envisages a distribution that is flexible and susceptible to change as economic, social, technical conditions or political priorities change.

3 Organizational efficiency of the judicial system and the trajectories of innovation processes

This analysis focuses on the functioning and organization of one of the main branches of public administration, the judicial system. In the last 20 years, many studies in *Institutional economics* have emphasized the pivotal role played by well-functioning judiciaries in fostering multiple economic activities, as judicial institutions are responsible for the concrete enforcement of the legal framework. Indeed, in a context of uncertainty and incomplete contracts, a well-organized and then high-performative judicial system cuts down transaction costs and opportunistic behaviors by acting as a deterrent against economic agents' deviations from previously signed contracts (Marciano *et al.*, 2019).

The multi-faceted nature of judicial performance is generally – and accordingly to the European Commission for the Efficiency of Justice (CEPEJ) - captured in terms of the efficiency of the justice system by two indicators, the *Disposition Time (DT) and the Clearance Rate (CR)*.

The Disposition Time (DT) indicates the estimated time needed to resolve litigious cases (in days) in a specific year and court/country and is usually computed as the number of unresolved cases divided by the number of resolved cases at the end of a year, multiplied by 365 days:

$$Disposition\ Time\ = \frac{Pending\ cases\ at\ the\ end\ of\ a\ period}{Resolved\ cases\ in\ a\ period} \times 365$$

Instead, the *Clearance Rate (CR)* is calculated as the ratio of the number of resolved cases to incoming cases in a specific year and court/country, multiplied by 100:

$$Clearance\ Rate = \frac{Resolved\ cases\ in\ a\ period}{Incoming\ cases\ in\ a\ period} \times 100$$

When the CR is about 100% or higher, the judicial system can resolve at least as many cases as those come in; conversely, a CR below 100% indicates that the courts are not keeping up with their incoming caseload.

Once scholars in *Institutional economics* have made clear the significant impact of judicial performance on the economic growth of a country, supporting with robust empirical evidence the importance of efficient courts in ensuring the effectiveness of a legal framework oriented to enhance economic outcomes, it becomes necessary to investigate what are the determinants and organizational principles that favor the proper functioning of judicial systems.

In this regard, at the end of the 1980s, M. Crozier, analyzing the essential data of the evolution of modern organizations, enucleates four crucial elements in the new logic. First, the ability to continuously innovate the product or service, the technique, and the relationship with the customer makes it possible to achieve success. To acquire and maintain this order of capabilities, it is necessary to manage resources differently, specifically human resources, by implementing forms of organization capable of freeing the autonomy and creative spirit of personnel in the search for flexible and innovative solutions.

Therefore, Crozier strongly supports organizational models inspired by the principles of Total Quality Management, which entails the circle of continuous improvement in the activities carried out day by day so that the search for an ever-higher quality model is uniformly widespread in the social space of the organization and well rooted in its culture. In this perspective, technical innovation and new ideas on services require both the initiative of potential innovators and a more fertile, open environment capable of receiving, communicating, and elaborating. The good or service has a better chance of success only if the user is considered a resource and his/her suggestion and learning skills are appropriately valued. There is no effective service without communication skills on both sides.

According to this logical approach, it is crucial to involve all operators at any level in the search for solutions and in the proposal of innovations is essential. These have to be placed in the conditions to develop their cognitive and relational qualities to the maximum, through training courses and the development of cooperation tools, up to the acquisition of autonomous managerial skills, functional to a balanced and integrated system growth.

The literature in *Innovation Studies* agrees that the centralization of decision-making processes within a rigid and top-down hierarchy, with a high level of

bureaucratization, risks stifling the development of innovative ideas (Amabile, 1988; Amabile *et al.*, 1996; Deci *et al.*, 1989; Gagné and Deci, 2005; Verzelloni, 2020). Therefore, the ability to innovate, if meant as one of the main determinants of the success of an organization, necessarily requires the coexistence of a series of factors that allow both its development and sustainability (Crozier, 1963; Crozier and Friedberg, 1977; Verzelloni, 2020):

- Internal specialization;
- Structural flexibility;
- Autonomy of the organizational actors, who retain a margin of maneuver and the possibility of experimentation;
- Availability of resources;
- Existence of an incentive system, including informal ones;
- Opening to the external environment;
- Effectiveness of internal and external communication and existence of adequate horizontal, top-down, and bottom-up cooperation and connection tools;
- Simplicity of the organizational structure and simplification of rules and regulations
- Presence of participatory leadership, which enhances individual skills and encourages intra- and extra-organizational learning processes and continuous training courses;
- Organizational culture to support creativity, innovation, and dissemination of ideas.

If the ability to innovate plays a fundamental role in the proper functioning of an organization, even judicial systems should have adequate innovation paths that allow the development of ideas and functional solutions for improving performance in terms of efficiency and quality of services provided to end users.

3.1 Digitization of the public sector

The high technology of services represents the primary source of innovation in the economy and society. The principles of transparency and simplification that increasingly characterize administrative action today materialize through telematic channels.

This explains the massive trend toward digitization of all administrative tasks, including the workflow of the judicial system. Indeed, a modern administration

needs to use information and communication technologies. The digital transition allows, on the one hand, the speeding up of procedures by operators and in relations with citizens; on the other, it is an indispensable prerequisite of the criterion of transparency, connected to the profiles of legality and anti-corruption, which are instrumental to the pursuit of efficiency of public agencies.

Among the primary purposes that the public administration seeks to achieve, therefore, also includes the adoption of technological and information models such as to be able to guarantee e-Government services to the community by implementing new technologies and reducing costs and times for providing services to final users.

4 The Italian Judicial System Organization

In Italy, no structural reforms have been adopted to organize the judges' work. However, with the approval of the National Recovery and Resilience Plan (PNRR), the Italian Ministry of Justice has committed to the European Commission to achieve specific targets concerning the reduction of the disposition time (DT) and over three-year civil judicial backlog following the principle of a reasonable duration of the trial.

Any reflection of an organizational-institutional nature, especially if oriented towards the innovation of the structures and rules of the judicial sector, should start from the observation that the Italian judicial system is, at least in part, a loosely coupled system: it is a complex organizational system in which interdependencies, behavioral rules and logics of action are characterized in a significantly different way from bureaucratic-hierarchical systems. A loosely coupled system is an organization characterized by a plurality of organizational units, which tend to be autonomous, with low technological and hierarchical interdependence.

In this sense, the Italian courts are - although similar in structure and partly in terms of material and human resources - each like an island in itself. The rules and practices of daily operations are very diversified, just as - from a micro-organizational perspective - the judges who create them are professionals assisted by the constitutional guarantees of independence and autonomy. This peculiar position produces its negative effects when it resolves itself into the claim of self-referential organizational solipsism. The system at the macro-

structure level does not have well-defined hierarchical links and is characterized by low interdependence.

It is both a centralized and localized system: the decision-making process is planned at the center, but then everything must be managed and re-evaluated at the local level under the responsibility of opeators who, if not by chance, have no managerial training and experience. The division of tasks at the center of a strictly functional type (for example, between the Ministry of Justice and the Ministry of Finance or between general directorates of the same ministry) is such as to induce behavior in "watertight compartments" which in parallel are directly reflected on the territory lacking any intermediate level of government.

From the central governance perspective, the system is diarchic in the sense that by constitutional provision, the administration of justice is the responsibility of both the Ministry of Justice and the Superior Council of the Judiciary (CSM)[1].

The former is responsible for managing human, instrumental, and technological resources for judicial activity, while the latter is responsible for governing, that is, managing and organizing the judges work and their leadership. The linear distinction outlined by the Constitution regarding the division of competencies between the two institutions increasingly shows its limits when tested by the facts and by the evolution of the respective spheres of action of the two institutions. On the one hand, the interventions to reorganize the Ministry's services, IT and organizational innovation projects have increasingly shown the need for support by the judges, the local judicial management, and the CSM. Likewise, in the CSM, the centrality of the government of the judiciary of the correct and efficient management of ministerial resources and of the projects on which the (few) resources are allocated is increasingly felt.

The effectiveness of the judicial action, the ability of the judicial offices to be active subjects of the development of the individual territories entrusted to their care, and therefore credible institutions, the possibility, in a nutshell, of rendering a just justice in adequate times are systematically dependent on ministerial policies. The segmentation and parceling out of responsibilities between the periphery and the center and, in the center, between the CSM and the Ministry have worse consequences when considering other factors: a) the coexistence within the system of a bureaucratic component (administrative officials) and a professional one (judges), each of which expresses its cultural background,

[1] *Articles 105 and 110 of the Italian Constitution.*

operates according to distinct professional and behavioral paths and responds to differentiated (formal and substantive) rules; b) the fact that the professional body of judges is organized according to constitutional directives of independence and autonomy which outline wide discretionary margins in the organization of their work with inevitable (also, but not only) negative repercussions concerning the needs of the homogeneous organization of services and standardization of procedures.

Both components (the judicial and the administrative one) are still not inclined towards a synergistic managerial approach (although with a very different gradient, as administrative managers today operate and are then evaluated by the Ministry of Justice in a certainly more stringent way on the results and the expenditure budget management). Above all, the professional component has for too long discounted a generalist conception of the function for which, for example, the judge, especially if he/she has been in service for many years, is considered (or self-certifies) competent to deal with any type of managerial and non-legal issue.

At the central level, there is no doubt that it is necessary to rethink the national judicial system's governance methods. We need civic courage, political will, and institutional seriousness to move towards a new and more modern judicial organization (Sciacca *et al.*, 2013).

5 Methodology

The public adiminisration as an organisation can be regarded as an 'open system', that is as a mechanism composed of variables that interact and condition each other, characterising the structure and thus determining the quality of outputs. Moreover, the variables interact with the environmental context in which the public administration is embedded (hence the 'open system'), and thus react in relation to the inputs that enter the system and the outputs that the system produces (possibly to adapt its behaviour, in the case of adaptive systems). Some constituent elements of fundamental importance for such a system (that is, the building blocks of the administrative system) are certainly to be found among the following: human resources, organisational structure, operations/procedures, technology, regulatory constraints. The effectiveness of an organisation depends on the degree to which its variables are consistent with the objectives for which

that organisation was designed, as well as in the ability of that organisation to cope with major external disturbances (organisational resilience).

We can thus affirm that a Public Administration is a complex system, dynamic in nature due to its capability (or even inability) to adapt to a varying context.

To describe such a systemic nature of a public administration, we will make use of the Systems Thinking and System Dynamics approach, the first one being a thinking approach where we can find several tools for describing (qualitatively) the complex structure of a system as well as its potential (still qualitative) behaviour over time; the latter, being the quantitative counterpart of the first one, particularly apt at describing a system's structure and then simulate its behaviour over time as well as its reaction to specific input (i.e.: policies).

In a first instance, we will use one of the qualitative Systems Thinking tools, causal loop diagrams (CLDs) to describe how the technological innovation in terms of "digital readiness" of a court can help reduce the backlog of cases by increasing the overall productivity of all the staff in a court (hence reducing DT and increasing CR). We will also show how innovation will support and speed-up such a technological transition and how innovation can be further sustained thanks to an institutional context (Ministry and CSM) that is capable of favouring the diffusion of such innovation.

By borrowing the concept of the general "workrate" from the project management sector, we can see how the typical "clearance rate" of Courts is indeed equivalent to such a PM workrate.

Workrate = Tasks To Do (tasks) / Avg Task Processing Time (time_unit)

Or

*Workrate = Workforce (ppl) * Productivity (tasks/time_unit*ppl)*

Borrowing a Stock & Flow diagram representing a general process for tasks development from the System Dynamics literature on Project Management, we have the structure shown in the next figure.

Which, if we substitute "cases" to "tasks", becomes:

Avg. Workrate (cases/time_unit) = Number of cases in the backlog (cases) / Avg. Disposition time (time_unit)

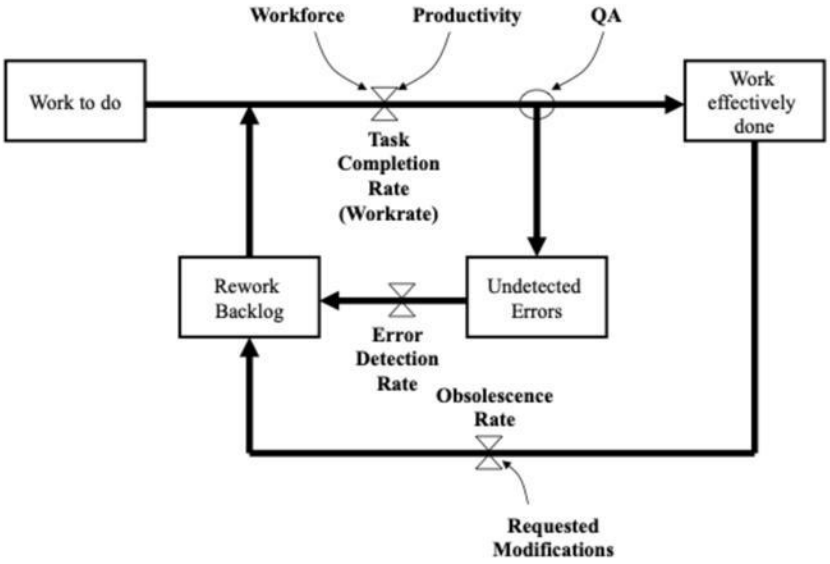
But also:

*Actual Workrate (cases/time_unit) = Available Workforce (ppl) * Avg. Productivity (cases/time_unit*ppl)*

Where:

Task Completion Rate → Clearance Rate

Work To Do → Cases in the Backlog



Source: Lyneis et al. (2001)

Even though these models have been contextualised mostly in the field of project management, they represent the basic stock & flow structures to depict development processes, that is those processes meant to carry out work, hence including working out judicial cases, from their opening to their final closure (with potential reworks in-between).

It is worth noticing how not only the availability of (proper) staff influences the Clearance Rate but also Skills & Experience (meaning the competences owned by such resources) as well as Quality of Work, which all contribute to the capability to carry out the tasks still to be done (and those that in the meanwhile are piling up in the backlog due to new cases being filed to the court).

Technological Innovation can be considered as part of the available resources with an acceleration effect on the capability to carry out tasks more efficiently, hence contributing to the effectiveness of the organization which can become more capable to respond to its "users".

Also Innovation at the level of the Organization can solve several efficiency issues by making sure that there is always the right resource in the right place.

Additionally, the dialogue between Courts (under the coordination of CSM, the Higher Magistracy Council) and the Ministry of Justice tend to make policies to be followed much unclear for Courts, who tend then to manage problems on their own without leveraging on the knowledge acquired by the whole systems (hence leveraging on best practices and avoiding worst practices)

6 The proposed model

Our analysis starts from the consideration of an existing Backlog of cases that the Court is not able to manage according to a required/desired Service Level (Desired/Required Disposition Time?). As the backlog increases, the President of the Court will realize more and more that there's a need to increase the capability of the court to manage such a backlog according to an acceptable timing. This means increasing the court's equivalent work-rate (which we can assume is the Clearance Rate?), that can be achieved either by increasing the available human resources (which we are not considering in this CLD) and/or by increasing the staff productivity, for example through technological support, aimed at easing work and speeding up average tasks duration. Increasing the technical support here implies augmenting (over time) the digital readiness of the organization.

The Digital Readiness of Courts is impacted by several organizational aspects that we have tried to capture in the CLD represented in the following Figure.

As the Backlog increases, the avg time allocated to study new digital solutions will decrease, hence decreasing over time the stock of digital readiness of the court. This in turn will decrease the clearance rate, thus augmenting again the backlog. But reinforcing loop R1 can also be read in a positive way since as the DR increases, CR increases, backlog will decrease and so there will be more time two study additional DR solutions, hence over time increasing again DR.

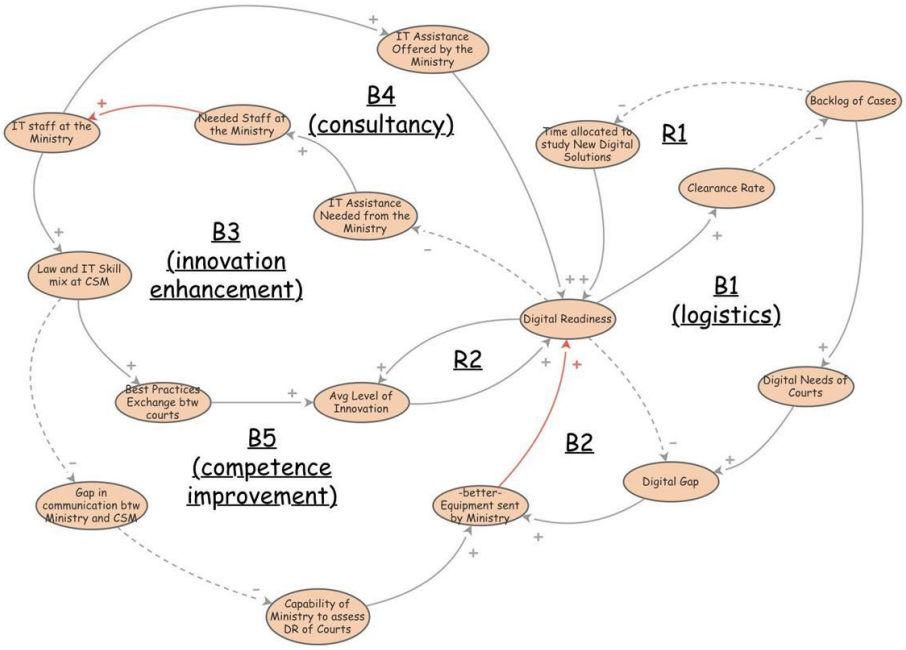
So Digital Readiness of the Court can be increased over time thanks to actions put in motion by the Head of the Court in order to innovate but it can increase also thanks to the overall average level of innovation of the other courts (reinforcing loop R2), in a process of best practice exchange. This process however can be slow if the starting number of Digital Ready courts is low.

Also, as the backlog increases, the court will start to perceive that they have higher digital needs, which will in turn express a higher amount of orders of digital equipment/solutions sent to the Ministry. Assuming the latter is capable of assess effectively the digital needs of courts, it will in will send new equipment

which, over time (red arrow means a delay acting), will increase digital readiness (Question: what about Knowledge?), hence in the long run decreasing the backlog again (Balancing Loop B1).

On the other hand, increasing DR implies a decrease in the gap and hence a decrease in the equipment sent by the Ministry which, over time time, will imply a decrease again of the DR through its depreciation. (Balancing loop B2).

When the DR is not good, the Courts will require Assistance from the Ministry, which will then have to find the necessary staff to cope with incoming requests. Once the needed staff will have been found, this in turn will imply an increase in the Skill Mix at the 7th Commission inside CSM. which will then make it possible to better exchange best practices at local and national level among the courts willing to innovate.



This will increase the average level of innovation, contributing in turn to increase the DR of the court (balancing loop B3 - Innovation Enhancement).

In turn, a higher amount of IT staff at the ministry will imply a better IT assistance offered by the Ministry, hence an increase in DR (balancing loop B4 - consultancy cycle).

On the other hand, when the law and IT skill mix at CSM is good, this will help reduce the communication issues that exist between Ministry and CSM, thus favouring the capability at the Ministry to effectively assess the DR needs of courts, hence transferring better equipment to the courts, ultimately increasing its DR...! (balancing loop B5, competence improvement).

7 Conclusions

The Judicial Systems is a complex System that needs to be analysed through tools capable of improving the understanding of its dynamics as connected to its organizational structure, both at local (Courts) and at national level (Ministry of Justice, Higher Magistracy Council, etc.)

Complex organizational systems can be analysed qualitatively through Systems Thinking (Armenia, 2019), modelled thanks to the Smart Model-based Governance approach (Armenia et al., 2018; Armenia et al., 2019) and simulated by means of System Dynamics models.

The Digital readiness of courts passes through an innovation process that can be sustained through the institution of a more effective (thanks to IT competences) operational unit at CSM aiming at a better cross-fertilization at national level of local innovations.

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Thematic Areas and Key Actions in Gender Equality Plans: Evidence from Italian Universities

Gail Denisse Chamochumbi Diaz*

University of Urbino
Via Saffi 42, Urbino, Italy

Federica Palazzi

University of Urbino
Via Saffi 42, Urbino, Italy

Annalisa Sentuti

University of Urbino
Via Saffi 42, Urbino, Italy

Francesca Sgrò

University of Urbino
Via Saffi 42, Urbino, Italy

* *Corresponding author*

Abstract

The European Union has been advocating for Gender Equality Plans in academic and research organisations since 2015, recognising them as a criterion for eligibility in Horizon Europe calls for research and innovation. The European Commission defines GEPs as a set of commitments and actions that aim to promote gender equality in an organisation through a process of structural change. Italian universities are now required to adopt GEPs in compliance with Decree No. 2/2019 and EU-COM No.152/2020. While most Italian universities have implemented their first GEPs, studies on their implementation and content are still limited. This study aims to explore the state of GEPs in Italian universities by analysing the extent of information disclosure in terms of actions planned. Special attention has been devoted to the area of work-life balance and organisational culture. Our study has found that universities are acknowledging the significance of promoting work-life balance and providing family care assistance. However, universities have not planned enough measures to address workplace well-being and mitigate threats to diversity and inclusion.

Keywords – Gender equality plan, diversity, gender gap, universities, empirical research

Paper type – Academic Research Paper

1 Background and theoretical framework

Across the world, emerging evidence has highlighted the persistence of gender inequalities in academia (European Commission, 2021; Górska et al., 2020). In this sector, the under-representation of women in senior academic positions, such as professors and university rectors, is the most visible manifestation of a gender gap (Van den Brink, and Benschop, 2012; Clavero and Galligan, 2021; Teelken et al., 2021), but it only represents the tip of the iceberg. In fact, the matter involves a broad category of subjects including students and technical-administrative staff (Barros et al., 2018; Oppi et al., 2021). Thus, it means that gender inequality in higher education affects the whole population of women both in the professional education careers and the labor area (European Commission, 2021a). Furthermore, the Covid-19 pandemic exacerbated pre-existing inequalities (UNCTAD, 2020; European Union, 2021). Scholars have demonstrated that women in higher education (such as teaching staff, technical-administrative staff, students, etc.) have been disproportionately affected by pandemic-related changes (Gòrska et al., 2021; Boncori, 2020; Guy and Arthur, 2020).

In response to this context, many international and European institutions have released guidelines, directives and recommendations aimed at promoting Gender Equality (GE) at different levels of society, both in the private and public sector. On this matter, the 2030 Agenda for Sustainable Development includes a specific goal called "gender equality" (SDG5) as one of its 17 goals, and it underlines the need to encourage interventions to accelerate progress, including the promotion of laws, policies, budgets and institutions that advance gender equality (UN 2015).

To promote a transformative and effective change towards GE, the European Union has been recommending and actively supporting the implementation of the Gender Equality Plan (GEP) in academic and research organisations (Council of the EU, 2015; EIGE, 2016): a set of commitments and actions that aim to promote gender equality through a process of structural change. A further step in that direction was taken in 2021. With the launch of Horizon Europe (HE) — the key funding program for research and innovation — a new eligibility criterion was

introduced to strengthen gender equality as a priority: organisations applying for HE funds are required to have a GEP in place.

In the literature on gender issues in academic institutions, GEP has been criticised as an ineffective policy instrument because the change process, required to implement it, faces resistance in different forms with different sources: lack of financial and human resources, and the burden of time (Bencivenga et al., 2017). Also, universities may decide on GEP measures for reasons which have little to do with a commitment to justice and equality: with a view to remaining competitive on the global market (Tzanakou and Pearce, 2019); or because they are legally obliged to do so (Ikävalko and Kantola 2017) to obtain funds, such as in the case of the HE programs. However, GEPs are also recognised as an essential means of creating GE awareness and serving to promote cultural change (Ovseiko et al., 2017; Barros et al., 2018; Clavero and Galligan, 2021; Barnard et al., 2016).

Despite a growing interest in gender issues in academia, little research has been done on GEP implementation and strategic actions identified to overcome gender inequalities (Clavero and Galligan, 2021). Given its recent mandatory introduction, more empirical research is needed to better understand how institutions have adopted this instrument. Therefore, this article aims to fill the gap exploring the content of GEPs in Italian public universities by responding to the following research question:

(RQ1) What thematic areas and key actions are included in the GEPs to identify and address gender inequalities and bias in academia?

2 Methodology

To achieve our goal, we have focused on Italian public universities and, following a qualitative research approach (Krippendorff, 2018), a content analysis on published GEPs was adopted. Italian academia is a particularly suitable context to examine gender issues. According to the last Global Gender Gap Report (WEF, 2022), in terms of economic participation and opportunities, Italy ranks 110 out of 146 states, behind several developing countries. Even though women outnumber men among graduate students, a marked inequality persists at the upper levels of the academic career (Baldarelli et al., 2016; Istat, 2019; European Commission, 2021). Furthermore, gender segregation persists: horizontal, regarding choice of education, as women are underrepresented in STEM disciplines, and vertical, with regard to women's involvement in the governance and top positions of higher

education organisations as they represent a minority in both cases (Barone, 2011; Roberto et al., 2020; Morana and Sagramora, 2021; European Commission, 2021, 2021a).

Specifically, the study analyses 52 Italian public universities to examine the content of GEPs that have been drafted and published on the institutions' websites. Content analysis appears particularly suitable for this study, because starting from a more complex text — such as GEPs — the coding enabled us to study the objectives and actions implemented by universities to tackle gender inequalities in their institutions. Moreover, in the last few decades, this technique has been increasingly applied to investigate gender issues (Polzer et al., 2021; Neuendorf, 2011), also in higher education (Oppi et al., 2021).

The method allows us to explore the types of objectives pursued and actions implemented in each strategic area included in their GEP. It should be mentioned that a preliminary analysis involved creating a database containing all the actions indicated by the universities, arranged in five thematic areas (Chamochumbi et al., in press). By doing so we decided to focus the content analysis on the first area, "Work-life balance and organisational culture", because, compared to other strategic areas, it is certainly targeted more frequently in terms of actions proposed by universities to tackle the gender issues in academia. During the content analysis of the first area, three coding levels were recognised. First, starting from the raw materials — which represent the set of actions listed in the thematic area — in a simple descriptive phrase, we have identified the labels of actions planned (sub-categories). Second, finding connections between the labels' actions, we have defined the categories by collecting actions based on their main purpose. Third, by following a logical progression, dimensions were identified, which has allowed us to analyse the planned actions from an all-round perspective.

3 Findings

On a sample of 58 universities, 89.65% of universities have published a GEP, while only 10.35% have not published the document. Therefore, the final sample consists of 18 large universities, 15 medium universities, 10 mega universities, 6 small universities, and 3 polytechnics. However, only 52 GEPs out of 58 have been analysed due to a lack of data and compliance with the GEP guidelines published by the Conference of Italian University Rectors (CRUI).

Findings show that Italian universities are implementing eight primary types of initiatives aimed at addressing the issues related to the area of work-life balance and organisational culture. The categories, as shown in table 1, aim to promote well-being in the workplace, encourage work-life balance, aid with family care, foster an environment of equity and diversity, strive for gender balance, implement gender equality plans, address threats to diversity and inclusion and provide student assistance.

The first category, "workplace well-being", encompasses initiatives that focus on: meeting the training and development needs of employees returning to work after a leave of absence, as well as enhancing the overall human resource development of the organisation; addressing work-related stress and developing strategies for its management; and providing specialised units offering psychological support and well-being services to the university's community. To ensure a smooth transition for employees who take leave due to parenting or illness, various actions can be taken, such as providing access to mentors who can offer support and guidance after returning from parental leave or for other reasons. Other actions include offering training to inform employees of legal provisions and possibilities related to parental leave, providing support to employees returning to work after leave (e.g., maternity, parental leave, illness) to maintain their career progression and developing guidelines for parental and maternity leave procedures to ensure consistency and a smooth process across the organisation. Instead, to promote well-being and tackle work-related stress in the workplace, several actions can be taken, such as setting up a counselling desk to offer support and guidance to technical personnel, administrators and teachers who may be at risk of work-related stress. Other actions include implementing procedures to identify critical areas that generate stress and finding solutions to overcome these stressors, conducting ongoing assessments of technostress levels caused by technology use, and sharing these findings with relevant stakeholders. Finally, to promote mental well-being, universities have planned actions that involve setting up specialised units or offices within the organisation to provide psychological support and counselling services to employees and implementing an internal organisational listening strategy, which involves creating mechanisms for employees to share their feedback, concerns and suggestions with management, and actions devoted to creating a positive and supportive work environment that promotes mental health and well-being.

The second category, "work-life balance", includes establishing policies and procedures that enable employees to work flexibly and remotely, as well as creating guidelines to ensure that work-related activities and events are scheduled with consideration for employees' personal lives and responsibilities. This can help employees balance their work and personal lives more effectively, reduce commuting time and costs and improve overall job satisfaction. Some examples of this action may include: setting up remote work policies and guidelines that outline expectations, best practices and tools for remote workers; providing employees with the necessary equipment and technology to work from home or other remote locations; offering flexible schedules that allow employees to work outside of traditional office hours or adjust their hours to accommodate personal needs, developing a "family-friendly" calendar that takes into account major holidays, school schedules and other important events that may affect employees' availability; providing training to managers and supervisors on how to plan meetings and work activities in a way that accommodates employees' personal needs and priorities; and encouraging open communication between employees and management to help identify scheduling conflicts and find solutions that work for everyone.

The third category, named "family care assistance", refers to the provision of facilities and programs to support employees with children, such as on-site child care services or access to summer camps, and involves making changes to the physical spaces and structures within universities to promote gender equality and inclusivity. Some of these actions are the creation of on-site child care, baby rooms, pink parks and summer camps, as well as the provision of vouchers for babysitting services and systems for holiday management able to balance work and family schedules.

The category of "equity and diversity culture" includes actions devoted to communicating, training, building and promoting a culture of diversity and inclusion. The actions to promote gender equality include publishing and disseminating information materials to reduce gender prejudices and stereotypes, organising meetings, conferences and seminars to highlight the social and economic role of women, providing training and awareness-raising activities on gender issues for technical-administrative staff, formulating and implementing guidelines for gender-inclusive language, strengthening the organisational unit dedicated to equal opportunities and identifying reference figures and structures for gender equality.

The category of “gender balance” regards integrating gender balance into universities' activities, processes and planning and involves a comprehensive approach to ensure that gender equality and inclusivity are considered in all aspects of university operations. To achieve this goal, it's necessary to take several actions, including presenting, publishing and disseminating the University Gender Report, which should include visual representations and be shared with both academic bodies and external audiences. Additionally, gender-disaggregated data should be collected and analysed to prepare the gender budget, and a systematic data collection process should be implemented for the Gender Budget. The Gender Report's results should be integrated into the university's strategic planning cycle, and the progress made should be periodically monitored and evaluated to assess its impacts.

To promote the category of “gender equality plan” in the university, it is essential to integrate it into the institution's overall strategy. This involves drafting and presenting an annual gender report to the academic community, organising information sessions about the GEP to increase awareness and establishing a dedicated GEP team responsible for monitoring data and tracking the progress of the planned actions.

The category of “threat to diversity and inclusion” refers to the anxiety and negative feelings that individuals from underrepresented groups can experience when they perceive that they are being judged based on a negative stereotype associated with their group. This can lead to reduced performance and motivation, which can reinforce the stereotype and contribute to a lack of diversity and inclusion in each setting. To avoid these issues, universities planned actions devoted to providing training to faculty and staff on ways to recognise and address stereotype threats, as well as implementing policies that promote inclusive practices such as avoiding biased language and creating a welcoming and supportive environment, and implementing an "alias career", which allows transgender professors, administrative staff and students to use a name and/or gender identity that is more comfortable and reflective of their gender identity, without having to legally change their name or gender marker.

Finally, the category "student care assistance" encompasses initiatives aimed at providing financial, social and educational support for students throughout their academic journey. Specifically, the following proposals have been developed to support students who are parents or caregivers: conduct an evaluation of tax and benefit regulations and propose a reduction in enrolment fees for students who

are parents under 25 years old; recognise and provide equivalency for students who are also caregivers, treating them as both students and workers; provide the same facilities and support for students who assist children, parents or relatives as those provided for working students; allow working students and students with children to access dedicated study plans, flexible class and exam schedules, and dedicated tutors; implement actions to facilitate the reconciliation of parenthood and studying; and ensure access to distance learning and other didactic activities for students who are caregivers or on maternity leave.

Table 1: exploring work-life balance and organisational culture initiatives in Italian universities.

Examples	**Sub-categories Actions devoted to**	**Categories**	**Dimensions**
providing access to mentors who can offer guidance and support; offering training on the legal rights and benefits associated with parental leave; facilitating a smooth transition back to work through tailored support programs, such as flexible schedules or reduced workloads; and creating guidelines for parental and maternity leave procedures to ensure clear and fair processes are in place.	post-leave (return to work) training needs and human resource development	Workplace well-being	Policies and Training
creation of a counselling desk to provide support to technical, administrative and teaching staff on work-related stress risks; implementation of procedures to identify critical areas that generate work stress; identification of solutions to overcome such critical areas that generate work stress; ongoing assessment and communication of the level of technostress.	overcome work-related stress and how to manage it	Workplace well-being	Policies and Communication

establishment of departments/positions/roles dedicated to psychological support; implementation of an internal strategy to actively listen to the needs of the organisation; measures designed to improve the mental well-being of the organisation.	establish units of psychological support and wellbeing service	Workplace well-being	Policies
reviewing and categorising tasks that can be conducted through remote means; implementation and standardisation of guidelines for smart working and telecommuting.	implementing and regulating work flexibility through smart and remote working	Work-life balance	Policies
avoid scheduling meetings during times when employees need to attend to personal or family commitments, such as school drop-offs or pickups, doctor's appointments, or religious observances; allow employees to prioritise and block off specific time slots during the day for personal or family-related activities, such as exercise, childcare or meal preparation; encourage managers to communicate with their team members about their availability and personal/family responsibilities when planning team meetings or events	the preparation of guidelines for planning meetings, work activities and teaching life consistent with private life (family-friendly calendar)	Work-life balance	Policies and Communication
on-demand babysitting services; provision of baby rooms and parks; arrangements with private organisations to operate nursery schools, kindergartens and summer camps; mailing vouchers for babysitting services; definition of contributions to provide access to nursery schools.	childcare, nursery programs and summer camps	Family care assistance	Policies

agreements with home services and assistance organisations to support non-self-sufficient individuals; expansion of care infrastructure at the university; agreements with alternative recreational spaces to provide additional support, creation of assistance services and spaces for individuals with disabilities, young children and other dependents; adaptation of university structures to ensure gender inclusivity	structural transformation to achieve gender equality in universities spaces	Family care assistance	Policies
implementation of a holiday management software; conducting regular surveys to identify the needs of employees for better work-life balance, aligning the Positive Action Plan (PAP) based on the analysis of the previous year's final balance to improve work-life balance.	implement Staff Holiday Booking System and services to reconcile workload with private life	Family care assistance	Policies
publication and dissemination of information materials aimed at reducing gender prejudices and stereotypes; giving greater visibility to women in institutional and scientific communications; organising meetings and conferences dedicated to promoting the social and economic role of women; hosting seminars to raise awareness and promote support for parenting and shared care.	communicate diversity and inclusion	Equity and diversity culture	Communication
incorporating a workshop or seminar on the topic of female entrepreneurship and gender equality within the annual Start-up Day initiative; conducting training and awareness-raising activities on gender issues for technical and administrative staff; organising training courses for the university population on topics such as equal opportunities, stereotypes and gender-based violence; providing individual mentoring for female staff members.	training in diversity and inclusion	Equity and diversity culture	Training

formulating and implementing guidelines for gender-inclusive language; strengthening the organisational unit dedicated to equal opportunities; identifying reference figures and structures in the field of gender equality; introducing monitoring tools to ensure gender balance; enhancing gender diversity and promoting the inclusion and well-being of male and female students; removing barriers to recruitment, retention and career advancement to promote equal opportunities.	building and promoting a culture of diversity and inclusion	Equity and diversity culture	Policies
presentation, publication and dissemination of the University Gender Report through graphic editing and sharing with academic bodies both internally and externally; collection and analysis of gender-disaggregated data for the preparation of the gender budget; systematic data collection for gender budgeting; integration of gender report results into the university's strategic planning; periodic monitoring of the results achieved through the gender report cycle; evaluation of the impacts produced by the gender report cycle.	integrating Gender Balance into universities activities, processes and planning	Gender Balance	Policies, Training and Communication
integrating the Gender Equality Plan (GEP) into the university's overall strategy; drafting and presenting the Gender Report on an annual basis to the academic community; organising information days to raise awareness of the GEP among the academic community; establishing a GEP Team responsible for monitoring data and the progress of the planned actions.	integrating Gender Equality Plan into universities activities, processes and planning	Gender Equality Plan	Policies, Training and Communication
training actions to combat stereotypes and prejudices; overcome gender stereotypes; promote awareness of gender equality.	addressing stereotype threats to diversity and inclusion by training	Threat to Diversity and Inclusion	Training

alias regulation for students in gender transition; reviewing the existing protocol that enables the use of aliases for students undergoing gender transition; updating the procedure for the alias identity, making it available not only to students but also to teaching and technical and administrative staff.	addressing stereotype threats to diversity and inclusion through policies	Threat to Diversity and Inclusion	Policies
evaluation of the modification of the tax and benefits regulation; proposal to reduce enrolment fees for students who are parents within the age of 25 years old; proposal for recognition/equivalence of students/caregivers as student/workers; proposal for the adoption of the same facilities provided for working students for students who provide assistance to children, parents, relatives; enabling working students and students with children to access dedicated study plans and class/exam organisation, also granting them access to ad-hoc tutors; actions aimed at facilitating the reconciliation between parenthood and study; guaranteeing didactic activities in distance learning to students who are caregivers or on maternity leave.	promoting student careers with economic, social and didactic support	Student care assistance	Policies

4 Conclusions

Our analysis contributes to the literature debate on gender issues through an in-depth analysis of the areas and actions included in GEPs aimed at promoting GE, with a specific focus on academia as a field requiring further study (Clavero, Galligan, 2021). We would like to offer a reflection for policymakers and university managers on the adoption of this novel means of fostering organisational change towards gender equity, and on the need to promote this process by investing resources and developing awareness at different institutional levels. Institutional stakeholders should develop and implement targeted actions areas which are most critical and most neglected, where a glaring gender gap is undeniable. Particularly, our study aimed to explore the measures that universities planned to

adopt to address issues related to work-life balance and organisational culture. Findings show that universities are increasingly recognising the importance of creating a supportive and inclusive work environment that values work-life balance and promotes gender equality. This can involve implementing initiatives such as work well-being programs, family care assistance, equity and diversity culture and student care assistance.

Based on the number of actions planned and disclosed in the GEPs, the categories of work-life balance, family care assistance and equity and diversity culture are the areas in which universities are more involved and committed. To promote work-life balance and family care assistance, universities mainly planned policy actions with the aim of creating set rules and procedures able to drive universities operations consistently with its values and goals; to improve equity and diversity culture, universities are strongly investing in training and communication. Instead, the categories in which universities seem to have planned fewer actions are those related to workplace well-being and overcoming threats to diversity and inclusion. It seems that the importance of workers' and students' mental health, and pre-and post-leave, are issues still undervalued by universities. Moreover, it seems that universities are still understanding which paths and plans in terms of training and policies to implement to address stereotype threats to diversity and inclusion. Finally, regarding the categories of Gender Balance and GEP, most universities seem to have planned policies, training and communication activities devoted to integrating these documents into universities' activities, processes and planning.

This research has certain limitations. First, the analysis focused on the actions proposed only in the first thematic area, while future research should consider what kind of actions were proposed in other strategic areas to combat specific gender inequalities. Second, the study observed the actions planned without focusing on the target population, whether students, teaching staff, technical-administrative staff, etc.; a more in-depth analysis should be conducted in this sense. Third, the present investigation observed the gender equality plans in their first versions in the Italian context; future longitudinal studies will enable us to better understand the evolution of this process and observe the changes over time.

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FinTech: Financial Inclusion and Women

Sabrina Ricco*

Department: Law and Economics of Productive Activities
Sapienza University of Rome
Via del Castro Laurenziano 9 - 00161 Roma (RM)

Maria Teresa Bianchi

Department: Law and Economics of Productive Activities
Sapienza University of Rome
Via del Castro Laurenziano 9 - 00161 Roma (RM)

* *Corresponding author*

Abstract

Can FinTech companies close the gender gap in access to financial services? In order to answer this question, the present research in the first part analyzes the literature that has been expressed on the diffusion of FinTech platforms and their approach to an inclusive financial system aimed at supporting and sustainable development of companies with greater difficulties in accessing credit, including women's businesses. The research is inspired by a study by the Bank of Italy on the analysis of FinTech platforms operating in the world and in Italy and then analyzes the specific data of a FinTech platform, through direct contact. The example of the research is the absence of comparable official data, while the originality of the work lies precisely in the desire to draw scientific attention to a well-known topic, but still little explored in terms of data and literature.

Keywords – FinTech, woman entrepreneurship, female, sustainability, inclusion

Paper type – Practical Paper

1 Introduction

Can FinTech companies close the gender gap in access to financial services? In the era of digital innovation, accelerated by the Covid-19 pandemic, innovative finance, better known as FinTech, is the protagonist of this new historical period. The pandemic has also encouraged and accelerated a process of change where technology and digitalization together with sustainability have been identified as

key factors of this revolution in the various sectors and in particular in the financial sector, which can no longer be limited only to the study of risk and return.

Regardless of gender, alternative credit access channels play a crucial role in encouraging inclusion in the broadest sense of the term, resulting in true sustainable finance. We are talking, therefore, about sustainable and technologically advanced finance. Companies operating in th1e FinTech sector represent the frontier of development of corporate finance and the traditional one aimed at reducing the environmental cost and guaranteeing greater value in terms of sustainability of the financial sector. The FinTech industry is ideally placed to take a prominent role on the global stage and positively influence the choices of the economic and financial system, in order to ensure that sustainability becomes increasingly mainstream in finance and the real economy. FinTech companies' intrinsic use of big data, artificial intelligence and real-time business and stakeholder information makes the industry a perfect model for implementing environmentally friendly and socially sustainable practices.

The financial services sector is currently undergoing a major transformation, with digitalization and sustainability as the driving force behind a new and more complex but at the same time sustainable process. While both concepts, digitalization and sustainability, have been studied in recent years independently of each other, the intersection between FinTech and sustainability has so far attracted only limited research, although the sector is becoming increasingly relevant as the financial system is an important element to enable a maintenance and growth of the global economy. In recent years, technological finance aimed at ensuring greater inclusion and, more specifically, sustainable finance has gained greater importance at company, national and supranational level. The union of techno-sustainable finance can represent one of the main levers to alleviate the impact of different factors that nowadays affect the various socio-environmental changes. It is worth remembering that the financial system, in general, has an essential function within the economy, it represents the nexus of the real economy. Traditionally the financial system provides a whole range of payment, investment and financing services. These essential functions of the financial system, in addition to sustainability, have been rethought and questioned in recent years, especially in the years marked by the pandemic, where digitization has represented one of the main engines of the financial system, digitizing products and processes.

A new sector therefore that of FinTech that is characterized by the undisputed combination of technology and finance, areas in which the presence of women is still at rather low levels, but what leaves even more perplexed is the deep gap between female and male entrepreneurs when it comes to raising funds for their companies and especially in the establishment of new entrepreneurial activities . This gap has been further accentuated during the pandemic, which has seen women engaged in the sectors most affected by the crisis and who have sometimes been forced to make drastic choices that have led to the closure of many companies. A situation that paints a potential social tragedy that accentuates and confirms an economic and financial gender gap.

A reason, therefore, for FinTech to be defined as a revolution of financial inclusion achieved through sustainable technology.

The document is structured as follows:

1. after a literature review, aimed at providing an overview of the definition of FinTech, we then move on to a systematic review of the existing literature in the field of financial technology integrated with the concept of financial inclusion. The SCOPUS database was used for the literature analysis;
2. the second part dedicated to research methodology introduces the case study of a specific platform operating in the FinTech sector;
3. The third part summarizes them ain findings.

2 Literature review

The review of the literature has shown that the issue of women's financial inclusion through FinTech is still a little addressed issue. Using the search terms "FinTech" and "Female" or "woman entrepreneurship" the research produced only 24 papers. Extending the search to the terms "FinTech" and "Inclusion" and limiting it to the areas "Economics, Econometrics and Finance" and "Business, Management and Accounting" identified 219 articles. Using the search terms "FinTech and Sustainability" the research produced an additional 138 documents; this certainly means that although it is a fairly attentive issue from a general point of view, the specificity of how FinTech can contribute to reducing the financial gender gap does not yet appear to be studied significantly. In addition, in general on the topic of FinTech and financial inclusion, the analysis of the literature has also shown that the topic has received attention only recently since most of the

articles are from the last five years. This is also an indication that the topic is becoming topical.

The prevailing literature concerns the market, historically identified as the main market, but it has been found that the activity of FinTech platforms of Chinese origin have recorded a strong contraction since 2018. The main cause behind the collapse of the Chinese market is to be found in the introduction, in that year, of a very strict regulatory regime, in particular in terms of capital requirements and registration requirements for FinTech operators, whose main purpose was to combat the high fraud rates that characterized the Chinese market itself (Ding et al., 2021; Cornelli et al., 2020).

To understand what this revolution of sustainable technology represents, it is good to start from the definition of FinTech.

The term "FinTech" is short for "FinTech". The literature identifies the introduction of the term in the early 1990s by former Citicorp chairman John Reed. According to this very first quote, FinTech identifies innovative financial solutions and is often used to identify start-ups that develop such solutions. The literature has recently revised this definition in more detail, identifying mainly with this terminology start-ups that offer solutions characterized by the application of IT systems in the field of financial services: payments, investments and financing.

Specifically, we talk about FinTech-Fin startups and FinTech-Tech ones: the first are those who focus on one or more financial services and try to optimize them through the use of digital tools, the second have a diametrically opposite process as they start from the development of a specific technology that is then applied to the financial sector.

According to the Financial Stability Board's definition, the term FinTech defines innovations in financial services made possible by technology, resulting in new business models, applications, processes or products with a decisive effect on financial markets, institutions or the provision of financial services (Financial Stability Board, 2017). In addition to lending operations, analyzed for the purpose of this research, and equity and debt crowdfunding transactions, the term FinTech applies to numerous other activities, including digital payments, insurance (Insurtech), supervision and regulation and open banking.

Often, however, FinTech companies are focused on a single service, but touch all sectors of finance: from payments to loans, from insurance (InsurTech) to banking and asset management, up to the use of technological tools to support

compliance procedures, compliance, compliance with rules, regulations, laws and reporting.

In recent years, the growing importance of FinTech has had a substantial impact on the banking sector as modern technological innovations, ranging from robotics to Artificial Intelligence (Hassani et al., 2020; Colom et al., 2010) and Machine Learning, are revolutionizing the traditional banking channel. This undoubtedly implies for the banking system an increase in digital investments such as to be able to respond to the growing and diversified financial needs and above all to be able to cope with competition from non-bank operators or even new banks specifically structured to make the most of technology. However, the introduction of new technologies by the banking system faces higher start-up costs in order to achieve them, but their marginal costs tend to be reduced to zero when economic pressure in terms of demand increases (Liao et. Al, 2020). The literature (Stulz, 2019) in particular tends to highlight how FinTech companies tend to offer cheaper and tailor-made banking products for both individuals and businesses and this undoubtedly represents a threat to the activity of traditional banks or could, on the other hand, represent an opportunity for the banking system if technological finance is considered as complementary and not alternative to traditional channels. Suffice it to say that, although the FinTech sector is rapidly evolving in the field of payment services, it is still struggling to grow, in terms of economic margins, in the field of other traditional banking services.

Of course, the relationship between FinTech and the banking sector is still evolving and under scrutiny by regulators, academics and technicians. However, the need for the banking sector to invest in digital technologies and to adapt quickly and comprehensively to the modern digital age should not be underestimated, but above all to meet the rapidly evolving consumer behaviors and to grasp the needs of those markets and customers that have long been outside the financial system. Some authors (Salampasis and Mention, 2018) argue that, many disadvantaged people in society are left out of the traditional financial market, thus creating inequality and information asymmetry (Bongomin & Ntayi, 2020). They also argue that the emergence of FinTech is closing the gap of those individuals and businesses that previously did not have access to the traditional banking channel, thereby creating greater equity and social and economic growth (Dawei et al., 2018).

Online services and products offer a lot of information to customers that could not have access without the use of digital services (Gomber et al., 2017, Gomber et al., 2018). Some authors (Sapovadia, 2018) believe that digital financial inclusion is different from traditional banking in that it allows access to customers without having to request historical documentation or detailed information as the use of artificial intelligence and big data allows to have an information set of data both known, as easily available from public sources, but also alternative data not common to the traditional banking system, such as purchase history, online behavior pattern, online transactions, etc. The use of artificial intelligence helps overcome the main problem of traditional financial inclusion (Gomber et al., 2017); Through machine learning and artificial intelligence it is possible to analyze and collect data from the web or current accounts to measure the solvency even of small companies and perhaps previously rejected by banks.

Let's not forget that the growth and development of an organization of any type and size strongly depends on financial inclusion, therefore digital financial inclusion is becoming increasingly central to the debate on how to ensure equal treatment even for those at the lowest levels of the pyramid so that they become financially active parties (Peric, 2015). Some authors believe (Salampasis and Mention, 2018; Bill & Melinda Gates Foundation, 2019; Wang and He, 2020), that financial inclusion is increasing thanks to the use of technological finance which, in addition to offering customers financial services at even more sustainable costs than traditional channels (Gomber et al., 2017), reaches users who are underserved or even excluded from traditional financial channels (Alameda, 2020).

It becomes easy to understand that the financial system becomes among the most important for pursuing social sustainability objectives. According to the latest Observatory of the Politecnico of Milan on FinTech and Insurtech, the financial sector ranks third (out of 11) after those of University and Education and Crops in terms of social sustainability, while otherwise consumers believe that the financial system cannot contribute to environmental sustainability. The tema is certainly to be paid attention at the level of literature, given that the eradication of poverty, which is achieved with financial inclusion and climate change are at the top of the agendas of the United States, the EU and are presented as among the most important of the 17 sustainable goals of the UN.

Entrepreneurial development is highly dependent on government support and financial resources (Ojiaku et al., 2018) and the financial inclusion of women entrepreneurs has attracted much attention, particularly for the significant impact

it has on each country's economy in terms of job creation and subsequent economic growth (Nguse et al., 2022; Malik et al., 2022). Typically, female entrepreneurs start their businesses with their own funds or with the help of family members and are often required to provide collateral to obtain bank loans (Mulili, 2020) and/or to pay different economic conditions than male entrepreneurs. Better access to financial services can improve people's employment outcomes, wealth accumulation and willingness to undertake new initiatives (Guiso et al. 2004, Guiso et al. 2021; Brown et al. 2019; C'elerier and Matray, 2019), but despite this, women remain unbanked or underbanked compared to men (Demirgu, c-Kunt et al., 2017; Guiso and Zaccaria, 2021; ke, 2021). Financial inclusion, therefore, promotes entrepreneurship and helps the female community (Fareed et al., 2017; Koloma, 2021) and new FinTech or FinTech can improve financial inclusion and close the gender gap in access to financial services (Demirgu, c-Kunt et al., 2018; Breza et al., 2020).

The literature analyzed highlights, therefore, that technological finance improves financial inclusion which in turn stimulates female entrepreneurship, moreover, the current state of research defines financial inclusion as a mediator in various reports, some authors (Demir et al., 2022; Chinoda and Mashamba, 2021) have argued that financial inclusion facilitates financial innovation and the link with growth and economic progress.

The use of new technologies and the use of non-traditional data allows FinTech companies to offer new products at lower costs and, at the same time, could stimulate incumbents to adapt to these new offers (Buchak et al., 2018; Philippon, 2019; 2020; Thakor, 2020), thus ensuring financial inclusion and therefore sustainable finance. However, the growing rise of the FinTech industry places a focus on the sustainable use of this service, some people are skeptical about using FinTech due to the presence of risks (Rathi, 2016). Some challenges relate to data availability and quality, accountability requirements to implement AI technology (Sundblad, 2018; Harkut and Kasat, 2019).

Some authors say that although FinTech industries develop rapidly, there is still a shortage of literacy in the sector (Shim & Shim, 2016).

3 Approach

The Occasional Paper number 702 of June 2022 of the Bank of Italy entitled "FinTech lending and financing platforms in the world and in Italy" analyzed

FinTech lending and funding platforms (capital and 1 bonds) in the world and in Italy. In particular, the study defines platforms as facilitators that connect applicants for funding with investors (individual or institutional) who intend to grant them. In addition, the same platforms can, with the necessary authorizations, be loan providers. The study found, and excluding China, that the platform market in the world has grown in recent years, reaching a transaction volume of 113 billion dollars in 2020. The same trend in terms of growth can also be seen in Italy where the granting of loans to companies and the sale of invoices increased.

The work reports the limitations of the study, also found during the drafting of this paper, as the data concerning the platforms are not easily available and updated and above all are often not consistent between the different sources. Starting from the information, used by the study to circumscribe the perimeter of the identified platforms, through the latest 2020 update of the report prepared by the Cambridge Centre for Alternative Finance (CAAF) (Ziegler et al, 2021) for international data and the Politecnico of Milan for Italian data, reported below in its main information, one of the three platforms included in the Occasional paper on access to credit for SMEs was then analyzed through direct contact.

3.1. The trend of the platforms in the world and in Italy

The Occasional Paper notes that transactions made through FinTech platforms have grown significantly in recent years, albeit with heterogeneous dynamics both at the level of jurisdiction and business models. Globally, in the second half of the last decade, platform activity increased until 2017, peaking at $419 billion, and subsequently contracting to $114 billion in 2020 (Figure 1). The trend mainly reflects what happened in China, historically the main market. By contrast, platform activity in other countries continued to grow; the outbreak of the Covid-19 pandemic does not seem to have had a significant impact (figure 2).

1 Issues of Economics and Finance, Platforms FinTech of loan and collection of loans in the world and in Italy, by Salvatore Cardillo, Antonio Ilari, Silvia Magri, Giorgio Meucci, Mirko Moscatelli and Dario Ruzzi, issue 702, June 2022, Bank of Italy.

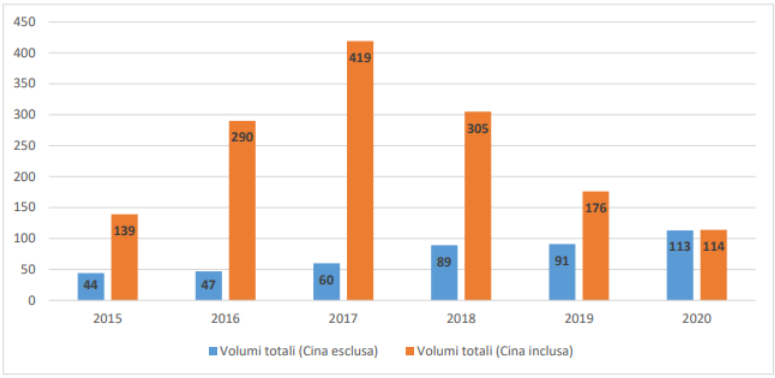

Fig. 1 – Size and growth of FinTech platforms: annual transactions (billion dollars)
Source: figure taken from the Bank of Italy's Occasional Paper, no. 712, June 2022 – FinTech lending and funding platforms in the world and in Italy – source used by CAAF

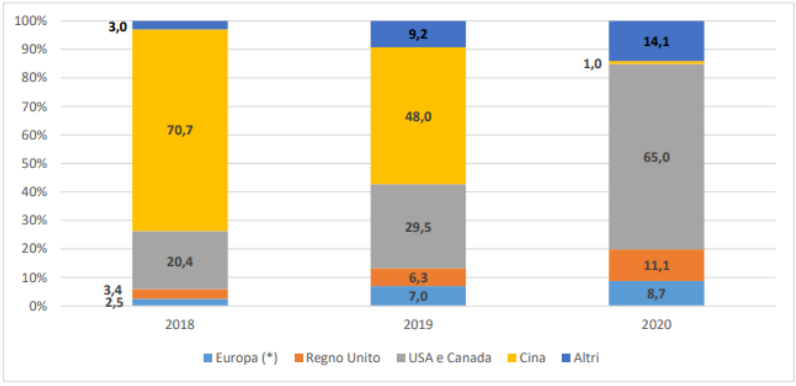

Fig. 2 – Market shares of FinTech platforms by geographical area (annual transactions, percentage values)
(*) Europe is considered in its geographical sense and countries that are not part of the European Union are also included. The United Kingdom is considered to be a stand-alone.
Source: figure taken from the Bank of Italy's Occasional Paper, no. 712, June 2022 –FinTech lending and funding platforms in the world and in Italy – source used by CAAF

Taking as a reference only the segment of loans, also the subject of this work, the Occasional paper highlights that it is precisely the segment of loans, in its broadest definition, that has recorded the greatest volume of growth (about 84 billion in 2019 and 100 in 2020) and also in terms of growth rates (figure 3).

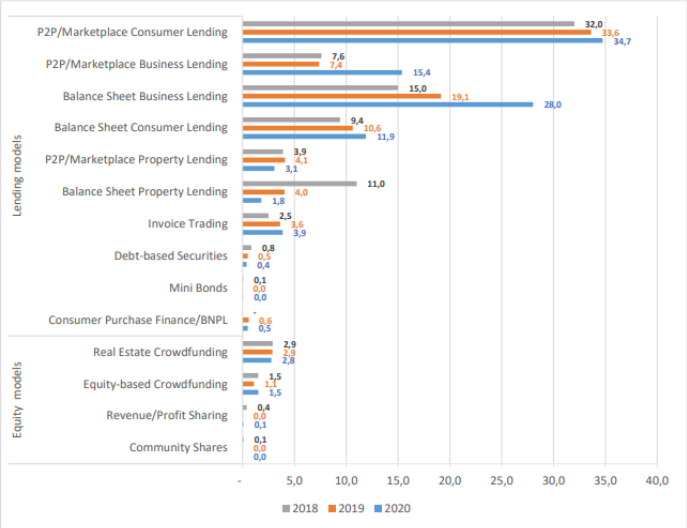

Fig. 3 – Transactions on FinTech platforms by activity and business model (excluding China, billions of dollars)

Source: figure taken from the Bank of Italy's Occasional Paper, no. 712, June 2022 – FinTech lending and funding platforms in the world and in Italy – source used by CAAF

The Occasional paper then analyzes the FinTech platform market in Europe which shows that the market has experienced a high increase in recent years: the value of annual transactions increased from 1.5 billion dollars in 2013 to 22.6 in 2020 (figure 4). The study highlights in particular how the United Kingdom is the largest player in terms of total transaction value.

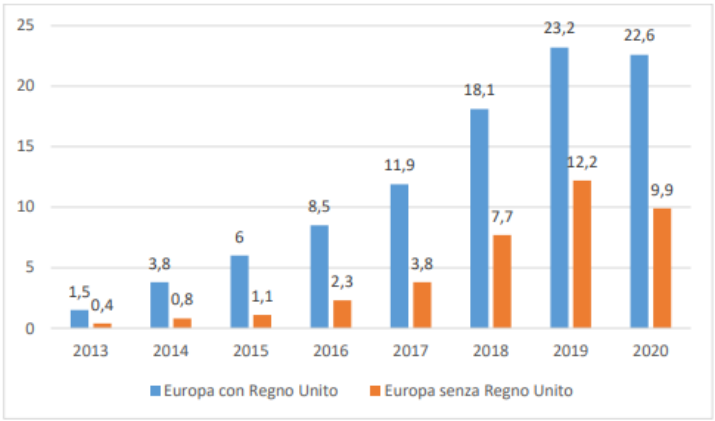

Fig. 4 – Transactions on FinTech platforms in Europe (billion dollars)

Source: figure taken from the Bank of Italy's Occasional Paper, no. 712, June 2022 – FinTech lending and funding platforms in the world and in Italy – source used by CAAF

As for as Italy is concerned, the Occasional Paper highlights how the Italian market has also grown in recent years. Addition, the study confirms that in Italy, even more than in the main European countries, the activity of the platforms is mainly directed towards loans, while capital investments represent a smaller share (figure 5). In the case of Italy, the loans mainly concern companies and invoice trading (Figure 6).

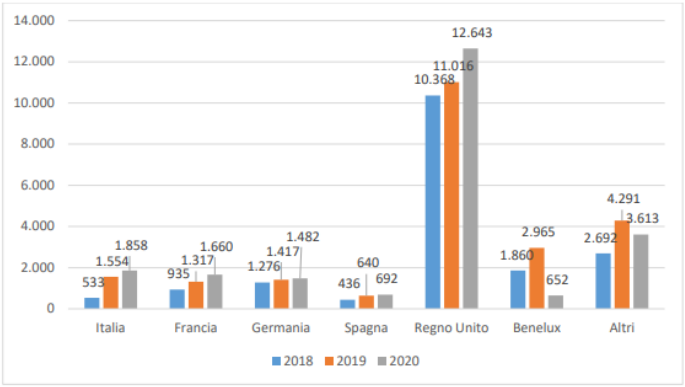

Fig. 5 – Transactions on FinTech platforms in European countries (million dollars)

Source: figure taken from the Bank of Italy's Occasional Paper, no. 712, June 2022 – FinTech lending and funding platforms in the world and in Italy – source used by CAAF

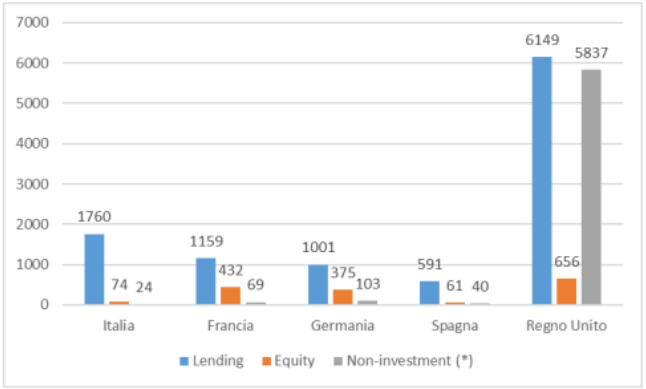

Fig. 6 – Transactions by market segment in the main European countries (million dollars; 2020)

(*) The non-investment category collects donations, the financing of activities in exchange for products or non-monetary awards (reward-based crowdfunding) and other forms of subsidized financing to micro enterprises (crowd-led microfinance).

Source: figure taken from the Bank of Italy's Occasional Paper, no. 712, June 2022 – FinTech lending and funding platforms in the world and in Italy – source used by CAAF

The Occasional paper, to analyze the Italian FinTech market, used data taken from the publications on alternative finance of the Politecnico of Milan (Italian Report on CrowdInvesting and Alternative finance for SMEs in Italy 2017a-2021a e 2018b-2021b), information and data collected through direct contacts with platforms or from the internet. The reference period is not the calendar year, but the twelve months ending in June; The most up-to-date data refer to the period July 2020-June 2021. The study distinguishes that financing can take place through the granting of a loan (social lending and invoice trading) or through the subscription of capital or minibonds (equity and debt crowdfunding). In general, the study defines platforms as facilitators that connect individuals or companies seeking funding and investors who intend to grant it (marketplace platforms).

A fundamental aspect to consider is that for equity crowdfunding since 2012 a dedicated legislation has been introduced in Italy, merged into the Consolidated Law on Finance, the lending activity is not subject to a specific legal framework, therefore, the activity of the loan platforms is freely exercisable, but must be carried out in such a way as not to violate the reserves of activities regarding the collection of savings, provision of credit to the public, provision of payment services and credit mediation. If the platform operator intends to participate in the provision of loans (balance sheet platforms) or independently manage the payment flows connected with the operation of the platform, it must be equipped with the necessary authorizations in accordance with the UPC (e.g. respectively as a financial intermediary pursuant to art. 106 TUB, as a payment institution or EMI). More often, platforms make use of the collaboration of authorized parties to carry out confidential activities and are limited to providing ancillary services and creating contacts with other companies in the credit chain, such as those assessing the creditworthiness of customers or securitizing loans; if among the lenders there are intermediaries authorized to grant loans, the activity of the platforms could, , be configured as credit mediation (art. 128-sexies TUB) and require registration in a list kept by the Body of Agents and Mediators (OAM), subject to possession of the requisites prescribed by law.

In Italy, many active platforms are authorized to operate as payment institutions (IP) or agents of Community payment institutions and EMIs; others have entered into cooperation agreements with Italian or EU payment service providers.

The Occasional paper found that as of June 2021, 28 digital platforms were active: 22 for business financing (of which 14 specialize in real estate) and 6 for

household financing. Reporting only the data of interest for this paper, it is highlighted that the market for loans to non-real estate companies and households is highly concentrated. Loans to non-real estate companies are still contained, but rapidly expanding: they increased from 80 million disbursed between July 2018 and June 2019, to 150 in the following 12 months, reaching 340 in the last period ending in June 2021. Almost all of the funding is provided by three platforms: Credimi, which collects only from institutional investors, Opyn, and October (figure 7).

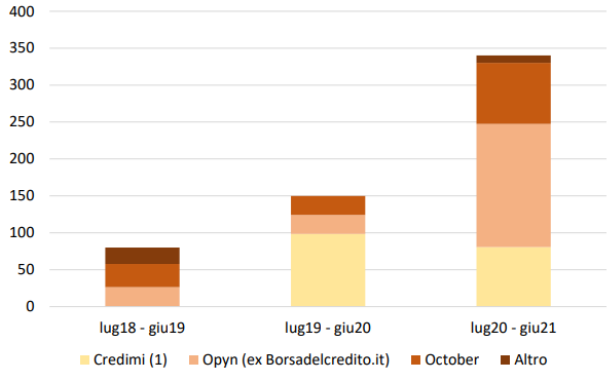

Fig. 7 – Loans to non-real estate companies (annual flows, million euro)

Source: figure taken from the Bank of Italy's Occasional Paper, no. 712, June 2022 – FinTech lending and funding platforms in the world and in Italy – source used by CAAF

Finally, the most recent public data of the Italian FinTech association are reported and relating to the growing volume of loans granted to the number of SMEs in the period 2019-2022 (figure 8). In 2022, over 4.5 billion euros were disbursed to Italian SMEs, for a total of 9.9 billion euros in the period 2019-2022.

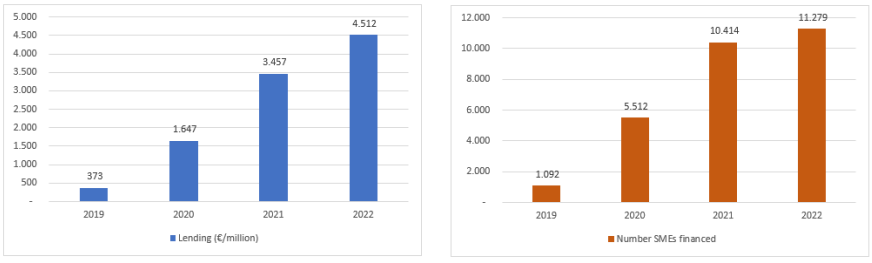

Fig. 8 – Volume of loans disbursed and number of SMEs financed (2019-2022)

Source : ItaliaFinTech Association. Our processing.

3.2 The case study

This paper, in order to respond to the research demand, aims to analyze a FinTech platform operating in Italy and grown in recent years with the aim of expanding the financial inclusion of SMEs.

The press review of "Il sole 24 ore" of March 16, 2023, reports as the winner and in the Diversity & Inclusion category of the Fintech Awards 2023, the FinTech platform Opyn, one of the realities also cited by the Bank of Italy study and case study of this work.

The information described below was acquired through direct contact with the corporate structure of the platform. Opyn describes itself as a human FinTech which, through its technology, offers fast and digital financial services, on the one hand, to companies in order to facilitate their access to credit, and on the other, by simplifying the work of financial institutions. Opyn is a reality with three souls: Fin + tech + human.

Founded in 2012 (figure 9), it is now one of the main marketplace lending for SMEs operating in Italy, having opened this channel of access to credit for companies for the first time in Italy. It is supervised and authorized by the Bank of Italy and Consob to play the role of mediator between supply and demand, between companies and lenders. Finally, in 2022 it expanded its offer with the launch of a new short-term installment loan dedicated to B2B both online and in physical stores.

Opyn is a brand managed by a corporate group, whose holding company is Business Innovation Lab Spa, which controls 100% of two other companies: Mo.Net Spa and ART SGR Spa.Mo.Net is the group company authorized to carry out payment services related to money loans. ART SGR is authorized to manage alternative investment funds reserved for professional investors. These funds lend money through the Opyn platform.



Fig. 9 – Milestones
Source: Opyn Sustainability Report 2021

Through its processes and technology, Opyn aims to be a sustainable reality and above all aimed at ensuring greater financial inclusion. The platform has developed a specific algorithm that allows you to look at new and more effective data with the aim of making those realities that were previously excluded access to credit.

In particular, going to analyze the data of the period 2018-2022, it is clear how Opyn responds perfectly to that growth trend that has characterized the world of FinTech. Growth confirmed also in the pandemic and post-pandemic period (Figure 10, Figure 11).

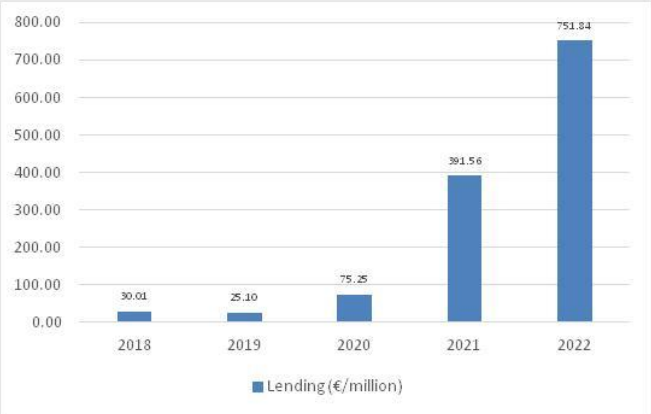

Fig. 10 – Lending (EUR/million)
Source: Data provided by Opyn. Graphical representation of our processing

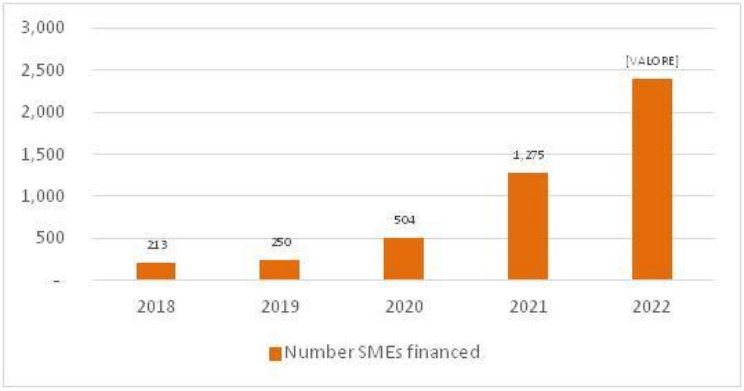

Fig. 11 – Number SMEs
Source: Data provided by Opyn. Graphical representation of our processing

As can be seen from the data and documentation acquired, financial inclusion is a goal for Opyn, evaluating entrepreneurs for their bankability, without any bias related to geographical origin and sector (Figure 12, Figure 13).

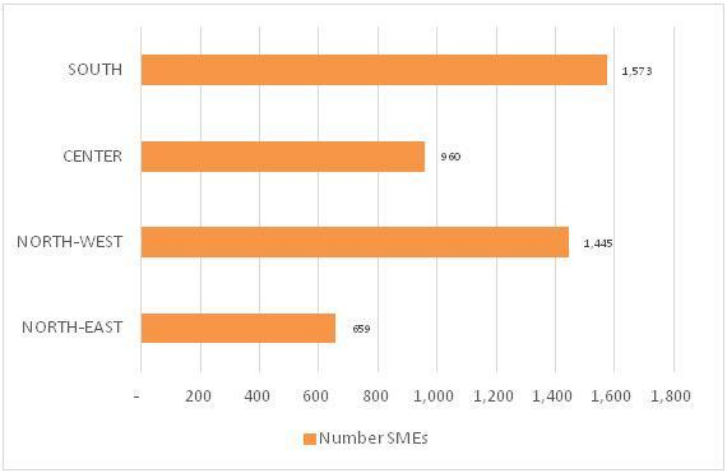

Fig. 12 – Geographical distribution of the enterprises financed
Source: Data provided by Opyn. Graphical representation of our processing

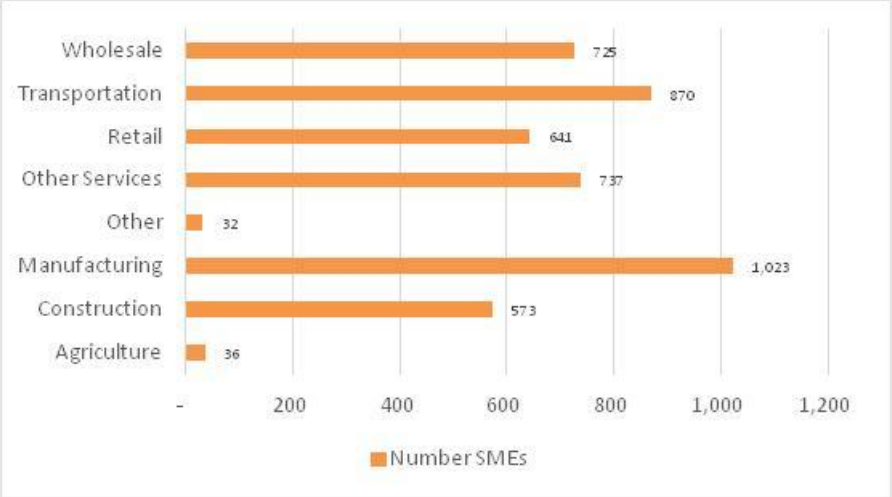

Fig. 13 – Sectoral distribution of the enterprises financed
Source: Data provided by Opyn. Graphical representation of our processing

Going to analyze the information, it is possible to affirm that the growth trend is also confirmed with regard to women-owned companies, whose greatest increase in terms of numbers and values is also confirmed in the pandemic and post-pandemic period (figure 14, figure 15)

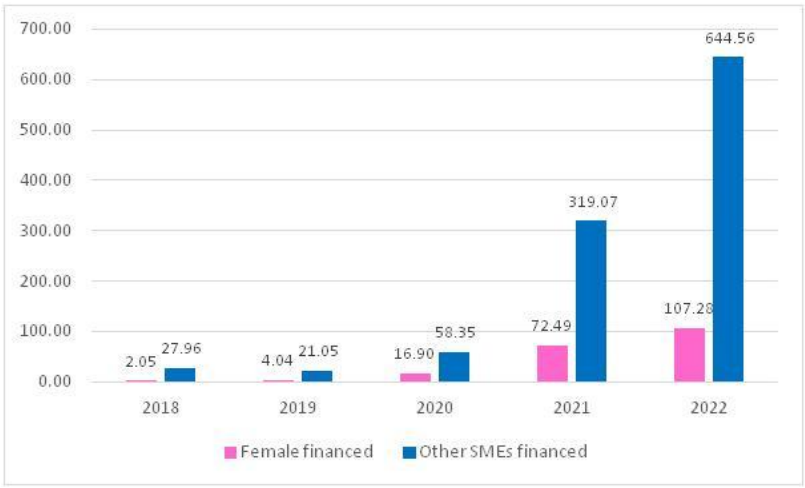

Fig. 14 – Women's enterprises financed vs. the rest of enterprises (EUR/million)
Source: Data provided by Opyn. Graphical representation of our processing

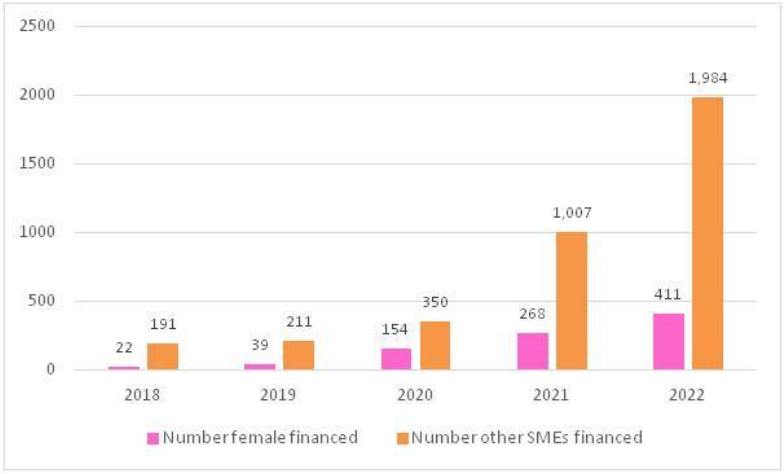

Fig. 12 – Number of female enterprises financed compared to the rest of the enterprises
Source: Data provided by Opyn. Graphical representation of our processing

4 Conclusions

Women in general still face significant hurdles when it comes to accessing the credit needed to build and expand their business.

Financial inclusion is one of the main tools to reduce gender inequality in the economic system and to achieve one of the Sustainable Development Goals. In fact, it is clear that gender equality also passes through economic independence and how for this it is essential a greater and more qualified participation of women in the economic system and therefore in the entrepreneurial fabric.

As regards access to finance, women's businesses being smaller and specialized in less productive sectors are less attractive to investors, moreover, companies run by women are perceived as riskier for a cultural issue. The result is that applications for funding from women entrepreneurs are often not accepted and when they are, compared to men, women find themselves paying higher interest and having to accept more stringent conditions and so most of the time women mainly use personal or family resources. This confirms what emerges from the analysis conducted by our study, namely that women's applications for funding are minor and therefore it is possible to affirm that: women do not ask or in any case ask in a limited way, credit to the financial system compared to the total of companies. As analyzed and demonstrated by the case study, the entry into the economic and financial system of technologically innovative financial platforms, FinTech, contributes to the financial inclusion of women's businesses. It is

therefore possible to assume that, albeit in small numbers, women-owned companies that access these new channels obtain positive responses in terms of access to credit. The case we analyzed, shows that the operation of this platform has increased by about 88% in terms of the number of companies financed between 2021 and 2022 and that the number of companies owned by women has also increased by about 53% between 2021 and 2022.

So do platforms help close the gender gap in access to financial services? There is no doubt that FinTech companies are contributing, giving a crucial boost through digital financing and alternative channels, to access to credit for subjects not easily served by the traditional financial system, thus ensuring greater participation and inclusion in the financial market and guaranteeing the sustainability that is obtained only when the economic, environmental and social dimensions interact.

The limit of the research is that the data on SMEs that turn to FinTech platforms are still few and more generally there are no data available with which to carry out comparative analysis at national and international level and therefore one of the indications of this work is precisely to bring to attention the need to start collecting disaggregated data, by gender, with specification by activity, by size, by location, in the financial sector, agreeing at international level also on a common definition of female enterprise.

Certainly, a greater availability of gender-disaggregated data is the first step to measure the gender gap in terms of financial inclusion that is actually recorded in the various countries and to understand how to address this gap more effectively also through the continuous comparison between traditional channels and innovative channels of access to credit.

Another limitation of the analysis conducted on the surveys on FinTech platforms dedicated to lending is that the platforms are still few and even if the theme appears attentive it is certainly still contained in the results.

Therefore, the originality of this work lies in drawing attention precisely to the lack of information and regulation on the subject of FinTech platforms, an information gap to be filled by drawing the attention of the authorities for greater regulation and the financial system to develop effective policies to attract and support companies with greater difficulties, as well as to start collecting and making public gender-disaggregated data on the their customers.

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Public Value Creation in Smart and Resilient Cities: An Integrated Framework to Guide Decision-Makers

Roberta Barbieri*

University of Salento
Department of Economic Sciences
Via Monteroni, snc – Lecce

Francesco Natale

University of Salento
Department of Economic Sciences
Via Monteroni, snc – Lecce

Pier Paolo Miglietta

University of Salento
Department of Biological and Environmental Sciences and Technologies
Via Monteroni, snc – Lecce

Giulio Paolo Agnusdei

University of Salento
Department of Biological and Environmental Sciences and Technologies, Via Monteroni, snc - Lecce

** Corresponding author*

Abstract

This research investigates the impact of smart city projects and initiatives on public value. A narrative literature review is performed, which leads to the proposed framework of measurement and evaluation. The model represents a useful information system to better understand the complexity of the process studied, to support policy-makers in defining winning strategies, and to make them accountable, ensuring public value creation and urban resilience. The study is preliminary, but provides broad insights for further research and application.

Keywords – Public value, Smart cities, Urban resilience, Integrated framework.

Paper type – Academic Research Paper

1 Introduction

Public value creation is the institutional purpose of public sector organizations (Moore, 1995; Meynhardt, 2009) and is defined as the production of what is good for and positively valued by the public (Moore, 1995; Benington and Moore, 2011). Thus, for public entities, the concept of value assumes not only an economic but also a social meaning, depending on the abilities of public managers (Moore, 1995).

In the complex process of creating public value, a key role is played by cities, which should become smarter and more resilient places. Adopting a holistic perspective, a city can become smart realizing investments on urban innovation (Nam and Pardo, 2011), that should create public value (Meijer, 2015; Neumann et al., 2019) and improve urban resilience (Zhu et al., 2009).

Once the development paths, aimed at minimizing resource consumption and maximizing the outputs, have been clearly defined, the greatest criticality arises from the complexity in measuring and assessing the effects of smart city projects and initiatives on the public value. To this end, this study seeks to answer the following research question (RQ):

> *RQ: How and to what extent do smart city projects and initiatives contribute to the overall creation of public value generating benefits for the city and its stakeholders?*

In order to answer this RQ, a narrative literature review was primarily carried out. The scientific literature on the analyzed field is multidisciplinary as it regards different bodies of knowledge ranging from public management, government and public policy to urban studies. The study reviewed journals and books, contained in Google Scholar and mostly published in English after 1995, the year in which Moore's theory was developed. The most relevant concepts were identified through a forward snowballing approach (Wohlin, 2014) and a new measurement and evaluation framework is proposed.

The study has potential practical implications because: (i) it can provide a useful tool to monitor and improve the performance of projects, guiding public managers in their decision-making processes; (ii) it can also enable citizens to acquire information, ensuring highest levels of participation and accountability.

The remainder of the study is structured as follows: Section 2 discusses the main theoretical concepts related to public value, smart cities and their role in the process of creating public value and increasing urban resilience; Section 3

proposes and discusses the measurement and evaluation framework; Section 4 presents general conclusions, implications and insights for further research.

2 Theoretical background

2.1 Public value theory

Recently, the public sector and its functions within the socioeconomic system were radically transformed to overcome the bureaucratic approach and the widespread inefficiencies (Borgonovi, 2004). In response to current challenges (i.e., the recovery of public accounts, the effectiveness of the adopted policies, the quality and efficiency of the provided services, the autonomy of managers, transparency, accountability, etc.) many scholars oriented their research efforts on a new approach, which goes beyond New Public Management and focuses on public value (e.g., Moore, 1995, 2000, 2005, 2013, 2014; Boyte, 2005; Stoker, 2006; Bozeman, 2002, 2007; Kettl, 2008; Alford and Hughes, 2008; Osborne, 2010a, 2010b; Talbot, 2010; Kalambokidis, 2014), both from a theoretical and practical perspective (Shearer and Williams, 2011; Van der Wal et al., 2015; Bryson et al., 2014; 2017).

The institutional purpose of public organizations is the creation of public value (Moore, 1995; Meynhardt, 2009). Since this concept is broad and complex, the literature does not yet provide a clear and shared definition of public value (Bryson et al., 2017; Panagiotopoulos et al., 2019; Hartley et al., 2017). According to Moore's perspective, it can be defined as the production of what is good for and positively valued by a community (see also Alford and O'Flynn 2009; Meynhardt, 2009; Benington and Moore, 2011). While for businesses the concept of value is mainly related to the economic dimension, for public entities it also takes on a social meaning, expressed by the perceived utility and level of community well-being (Moore, 1995; Bracci et al., 2019). Moreover, the creation of public value represents the main aim of public managers, depending on the ability to realize and coordinate three fundamental conditions, the so-called "strategic triangle" (Moore, 1995): (i) achieving substantial valuable results for all stakeholders; (ii) adopting sustainable and feasible initiatives; (iii) obtaining legitimacy and support. This approach focuses on governments, which are the explorers charged by society to seek public value, and suggests that public

managers need specific organizational-relational abilities to generate value (Moore, 1995).

The government certainly plays a key role as a producer and a guarantor of public value (Benington, 2011), but it is not the only actor involved (Peters and Pierre, 1998). Public managers need to adopt collaborative approaches (Meijer and Bolívar, 2016) also with non-profit organizations, businesses, media, citizens, and other institutions (Bryson et al., 2014).

Designing a process of public value creation without adequately measuring, assessing and communicating the achieved results is not possible. However, identifying what exactly should be measured and evaluated is not easy. Moore (1995, 2005) emphasized specific parameters which could serve to measure and evaluate public value, such as efficiency, effectiveness, accountability, fairness, and justice. Similarly, many authors argued that the parameters of public value are: quality, efficiency and effectiveness of public services, and aspirations of societies, referring to democracy, transparency, participation, trust, legitimacy, integrity, equal opportunities, and social inclusion (Kelly et al., 2002; Cole and Parston, 2006; Meynhardt, 2009; Ju et al., 2019; Twizeyimana and Andersson, 2019).

In the light of this, the definition of public value could include measures of input, process, output, and outcome (Moore, 1995, 2005; Bozeman, 2007; Meynhardt, 2009), but currently, there is no single bottom line (Kalambokidis, 2014). According to Moore (2013, 2014), public value accounting can be used to prove valuation, which is based on a broad aggregation of costs and benefits. Bozeman (2002, 2007) and Talbot (2010) support the use of a range of criteria to determine how much public value has been created or destroyed, but the emphasis on public value also encouraged the focus on profitability and reliability of public investments (Fisher, 2014), as in the case of smart and resilient city projects and initiatives.

2.2 The smart city toward public value and urban resilience

Cities are called to promptly solve several problems and face challenges, such as overcrowding, degradation, pollution, traffic, social inequality, crime, economic and health crises, natural disasters (Kabir et al., 2018; Kummitha and Crutzen, 2017). Taking advantage from the current context (e.g., the rapid spread of technologies, the growing sensitivity to environmental protection, the disruption of traditional cultural practices, etc.) (Estevez et al., 2016), there is a strong

opportunity to transform cities into smarter and more resilient places (Chourabi et al., 2012; Albino et al., 2015).

In fact, a smartly planned city must be also resilient (Bansal et al., 2017), i.e., able to absorb, adapt, and convert external pressures while ensuring urban safety in case of crises, hazards or disasters (Rus et al., 2018). However, there is no unanimity regarding what a smart city is and what should be done to get a city smart (Hollands, 2020; Meijer and Bolívar, 2016; Mora et al., 2019a). The scientific literature on smart cities can be considered twofold: a research trend focused on technologies, and another one adopting a human-centered, people-driven, holistic perspective, where technologies are exclusively instrumental in addressing local development needs (Mora et al., 2019a). The latter notion implies a multidimensional vision of smart cities, that involves six dimensions, i.e., economy, mobility, environment, people, living, and governance (Giffinger et al., 2007). A city is smart when investments (e.g., in human and social capital, traditional and modern infrastructure, etc.) boosts sustainable economic growth and high quality of life, with a appropriate management of natural resources, through participatory governance (Caragliu et al., 2011). Based on Nam and Pardo (2011) and other similar contributions (e.g., Camboim et al., 2019; Caragliu and Del Bo, 2019; Lee et al., 2014; Manville et al., 2014; Appio et al., 2019, Barrutia et al, 2022), the smart city represents urban innovation, which refers to new ideas, practices, and projects.

The outcomes of smart city projects have been discussed in a number of ways in the literature. Some scholars argue the expected benefits without considering public value (see Komninos et al., 2021; Gil-Garcia et al., 2021; Barba-Sánchez et al., 2019). Mora et al. (2019b) identified the outcomes of smart city activities in four benchmark cities. Although they did not specifically address public value, the results outlined can be summarized as the pursuit of three forms of public value: efficiency (cost savings), effectiveness (service improvement), and social challenge (sustainability, social inclusion). Meijer and Bolívar (2016) do not define the concept of public value, but they regard it as the outcome of smart city governance. According to Castelnovo et al. (2016), public value is defined in terms of direct short-terms effects and long-terms impacts of the projects implemented. The combined creation of both economic and social value is highlighted by Dameri and Benevolo (2016). Neumann et al. (2019), while acknowledging the vagueness of the concept of public value, state that it can refer to several

dimensions, including service quality, integrity, equal opportunity, and citizen involvement.

Under this umbrella, where a smart city is shaped by urban innovation projects aimed at public value creation, the city government becomes the leader of the city transformation process (see e.g., Giffinger et al., 2007; Meijer and Bolívar, 2016; Ojo et al., 2015; Esposito et al., 2021). Nevertheless, this process can be difficult to lead, and it may fail in different ways (Nam and Pardo, 2011; Ruhlandt, 2018). For instance, may lack innovative ideas and leadership (Nam and Pardo, 2011), select the wrong partners or mismanage relationships (Crosby et al., 2017), be driven by self-interest (Cabral et al., 2019), and have insufficient skills (Neumann et al., 2019). This represents a problem, as cities may invest in innovation projects, incurring economic and social costs, without realizing the expected benefits (Ruhlandt, 2018). For these reasons, the public value created by smart city initiatives so far has been questioned by several authors (see e.g., Kummitha, 2018; Komninos et al., 2021). While the ability of local governments is typically seen as crucial to explaining public value (Bryson et al., 2017; Cabral et al., 2019; Janowski et al., 2018), there is no systematic knowledge about how the implementation of a smart city strategy actually affects the public value creation dynamics of a city and the urban resilience. In this study, a new theoretical framework is proposed to fill this gap.

3 A new integrated framework

The performed narrative analysis identifies different concepts which represent the theoretical foundations of the proposed framework, described as follows.

3.1 Strategic areas of action

A city can become smart through the realization of investments going on urban innovation projects, which must be technically feasible and financially sustainable (Nam and Pardo, 2011). An innovation project can be understood as an intentional effort to develop new solutions that increase public value (Meijer, 2015; Van Winden and van den Buuse, 2017; De Vries et al., 2016; Neumann et al., 2019) and urban resilience (Zhu et al., 2009). These may vary in a wide range of ways that could have an impact on the public value (e.g., ends pursued, technological content, stakeholders involved, investment volume and funding, etc.) (Barrutia et al., 2022).

The framework concentrates on the approaches discussed in previous studies that are related to the main purpose of the projects and categorizes them into six *strategic areas of action* of the city, which recall the classification proposed by Giffinger and colleagues (Giffinger et al., 2007; Giffinger-Gudrun, 2010) (*Table 1*).

Table 1

Smart economy	**Smart mobility**	**Smart environment**
- Innovative spirit - Entrepreneurship - Economic image & trademarks - Productivity - Flexibility of labour market - International embeddedness - Ability to transform	- Local accessibility - (Inter-)national accessibility - Availability of ICT-infrastructure - Sustainable, innovative and safe transport systems	- Lack of pollution of natural conditions - Pollution - Environmental protection - Sustainable resource management
Smart people	**Smart governance**	**Smart living**
- Level of qualification - Affinity to lifelong learning - Social and ethnic plurality - Flexibility - Creativity - Cosmopolitanism/ open-mindedness - Participation in public life	- Participation in decision-making - Public and social services - Transparent governance - Political strategies & perspectives	- Cultural facilities - Health conditions - Individual safety - Housing quality - Education facilities - Touristic - Social cohesion

Source: Giffinger and Gudrun, 2010

3.2 Evaluation levels

The need to meet the growing needs of citizens, given limited resources, requires public entities to account and monitor the performance of their actions (Pollitt and Bouckaert, 2000). In this study, the ability to generate public value from innovation projects, framed within the different cities' *strategic areas of action*, is assessed at three different *evaluation levels*, which define the processes for improving strategic, managerial, and organizational performance (Borgonovi, 2004).

More specifically, the *strategic level* includes the solutions that public administration wants to provide for issues of collective well-being. At this level, the assessment of performance is very complex, due to the multidimensionality of the effects produced by projects and the number of actors involved.

The *managerial level* involves the translation of strategic guidelines into operational lines of action, and combines instances of correct business conduct, rational use of resources, and efficiency of action.

At least, the *organizational level* concerns the evaluation of results produced by a combination of human (i.e., the level of knowledge, skills, abilities, and growth potential of the human resources), organizational (i.e., level of innovativeness of practices, behaviors, procedures, and process, able to adapt to changes in the external environment), and systemic-relational (i.e., the relations established with stakeholders, citizen's engagements) factors (Borgonovi, 2004; Cepiku, 2018).

3.3 Evaluation dimensions and type of KPIs

Based on the different smart city outcomes in terms of public value, recalled in the previous literature (Meijer and Bolívar, 2016; Castelnovo et al., 2016; Dameri and Benevolo, 2016; Neumann et al., 2019; Mora et al., 2019b), the following dimensions were identified to assess the impact of innovative projects on public value:

1. *Effectiveness of intervention*, which aims to measure the outcomes and/or the long-term impacts of the project. Usually includes the broader goals that initiatives pursue (e.g., economic growth and employment, social inclusion and well-being, reduction of pollution, etc.);
2. *Quality of intervention,* intended to measure the satisfaction of citizens/end beneficiaries of the project implemented;
3. *Economic sustainability,* which aims to assess the efficiency in the use of economic resources and making wise investments;
4. *Organizational grow and innovation,* intended to assess different aspects, like the degree of technological innovation of projects, use of change management techniques and process reorganization/reengineering, creation of partnership, level of skills and know-how of actors involved, citizens' engagement, etc.

For instance, street lighting projects can reduce energy consumption and contribute to sustainability (*effectiveness of intervention*), improve the experience and the satisfaction of drivers and pedestrians (*quality of intervention*), reduce public lighting costs (*economic sustainability*), use innovative technologies and be

implemented in partnership with other parties (*organizational grow and innovation*).

The proposed framework links the evaluation dimensions (1) and (2) to the strategic level, while dimension (3) is related to the managerial level and dimension (4) to the organizational level.

In turn, each evaluation dimension must be synthesized by a specific set of *key performance indicators,* which should be S.M.A.R.T. (Specific, Measurable, Achievable, Realistic, Time-based) (Shahin et al., 2007) and represents the drivers for minimizing costs and maximizing benefits (Moore, 1995).

Assumed that the concept of public value takes on both economic and social meaning, and depends on the specific skills and capabilities of public managers (Moore, 1995), the measures lead to three forms of public value: (i) social, (ii) economic, (iii) intellectual.

The overall public value generated by the innovative projects in the smart city is then represented by a synthetic measure, that represents a careful weighing of all variables under consideration (see *Figure 1*).

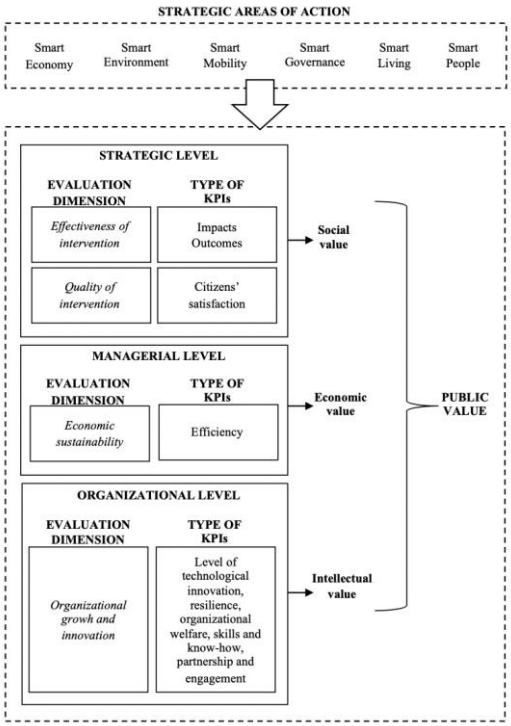

Figure 1 (Source: Self own)

4 Conclusions and implications

Public value is generated if public entities are able to optimize available resources by directing them toward organizational welfare (internal perspective) and the satisfaction of community needs (external perspective). The implementation of smart city projects and initiatives represents a mandatory choice to create value, providing stability and urban resilience. According to this perspective, public entities must be evaluated based on their ability to create value. To these ends, the proposed framework allows for clearly and timely measuring and evaluating the achieved results.

From a theoretical point of view, this study provides a deeper understanding of the relationship between the dynamics of public value creation and the smart city context, giving also evidence of how the types of projects and initiatives and the decisions taken by public managers can differentially affect public value. The dynamics underlying this process are heterogeneous and complex and require knowledge advances and adequate interpretation.

From a managerial point of view, the framework provides public managers with valuable information on how to guide their decision-making processes and manage the implementation of smart city projects and initiatives. The study highlights that public managers cannot rely exclusively on the alleged "intrinsic" positive features of projects, but rather must concretely measure and evaluate their performances, supporting appropriate investment decisions. Focusing on public needs satisfaction, economic balances and organizational well-being represents the best mix to ensure a positive impact on public value. From a citizens' perspective, the proposed framework can facilitate instead the judgment on urban performance and support accountability mechanisms.

4.1 Limitations and further research

The development of smart cities is an ongoing phenomenon which occurs differently based on the territorial setting. The proposed framework assumes that smart city projects and initiatives are framed in a specific area of action. Actually, projects and initiatives are generally transversal, having multiple purposes at the same time, resulting difficult to be categorized. In addition, determining exactly which elements should be measured to evaluate the effectiveness of a choice, the efficiency of a process, and organizational capacity requires further research efforts.

In fact, since the study is preliminary, it provides insights for further research developments, referable to: (i) the definition of specific KPIs for each evaluation dimension;; (ii) the determination of the relative importance (weight) of the KPIs, by applying MCDM method; (iii) the framework validation through its testing on real cases.

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The Effect of Digital Expertise of the Board on Corporate Innovation

Chiara Acciarini*

Sapienza University of Rome, Department of Computer, Control, and Management Engineering
Via Ariosto 25 - 00185 Rome, Italy

Riccardo Marzano

Sapienza University of Rome, Department of Computer, Control, and Management Engineering
Via Ariosto 25 - 00185 Rome, Italy

Alberto Nastasi

Sapienza University of Rome, Department of Computer, Control, and Management Engineering
Via Ariosto 25 - 00185 Rome, Italy

** Corresponding author*

Abstract

Innovation represents a key factor for sustainable growth and long-term success. However, despite most firms recognize its importance, only few of them are equipped and prepared to innovate. Previous studies have shown that various characteristics of the board, such as networks, behaviors, gender, and composition, influence a firm's decision to innovate. Even though recent transformations like the digital one and the Covid-19 pandemic emphasized the need for including directors with digital expertise to understand new technologies that affect business decisions, this role is still underexplored. Our study addresses this gap in the literature by exploring the impact of the digital expertise of the board on corporate innovation. Using data from 2527 U.S. listed large firms, our preliminary results show that the presence of at least one director with digital expertise significantly increases the likelihood that firms implement high-quality innovation strategies. The study sheds light on how specific professional expertise of directors matters for firms that decide to innovate and adds new evidence to the role of corporate governance in high quality innovation activities.

Keywords - innovation, digital expertise, board of directors, corporate strategy

1 Introduction

Innovation is vital for the growth and long-term success of modern business. Specifically, corporate innovation is today commonly considered a sustainable strategy for achieving superior performance (Kuratko *et al.*, 2014) and value creation (O'Cass and Sok, 2013). A recent survey of over 5000 board members from around the world revealed that firms focused on long-term results tend to consider more the innovation strategies (Cheng and Groysberg, 2018). However, according to BCG (2021), despite most of the firms believes that innovation is a priority, only 20% of global businesses are ready and equipped to innovate. Extant literature shows that a variety of board's characteristics influence the decision to innovate (e.g., Grühn et al., 2016; Arzubiaga *et al.*, 2018; Chang and Wu, 2021; Valenti and Horner, 2020). For instance, boards can proactively recommend a CEO change to increase the firm's innovativeness (Grühn et al., 2016). The study by Arzubiaga *et al.* (2018) finds that boards provide valuable knowledge to increase the innovation of small and medium family businesses. In addition, Valenti and Horne (2020) report that boards provide strategic contributions and valuable advice to the firms in term of innovation. Also, Chang and Wu (2021) show that the board connectedness enhances firm patenting activities. Nowadays, with the advent of recent transformations like the Covid-19 pandemic and the digitalization, firms need more than ever "board of directors who are digitally competent and understand the new technologies that are impacting business decisions" (David and Farzan, 2021, pp. 5-6). We therefore contend that the digital experience must be considered when determining the composition of the board.

Even though previous studies on innovation management investigated a variety of board's characteristics like their networks (Chang and Wu, 2021; Wincent *et al.*, 2009), their behaviors (Robeson and O'Connor, 2013), their gender (Wu *et al.*, 2021), and their composition (Chen *et al.*, 2022), we lack detailed insights into how directors with digital expertise direct the innovation strategies. For example, firms with different classes of directors tend to develop more new product lines and plans, according to Chen *et al.* (2022). Furthermore, while Wu *et al.* (2021) study the role of chief technology officers in association with the firm's patent application and with the quality of innovation, they limit their analysis to female executive representation.

In this study, we address this gap in the literature by exploring the impact of digital expertise of the board on corporate innovation. Specifically, we investigate this professional background through boards may affect innovation. We begin our analysis by gathering information from the proxy statements (DEF 14) published on SEC EDGAR including current and past employment of the board. A digital expertise is identified if specific digital-related keywords are included in these board's documents. We finally aggregate these directors' characteristics to construct a measure of digital expertise of the board. In addition, we follow Chemmanur *et al.* (2014) to measure corporate innovation through on patent-based metrics. In particular, we use the pattern of forward citations to define the firm's innovative activity in a year (e.g., Griliches, 1987; Ganglmair et al., 2021). As a result, we construct a database that includes patents, financial, and board information of 2527 U.S. listed large firms.

We then perform a panel data analysis following Maddala (1987) and find that the presence of at least one director with digital expertise significantly increases the likelihood that firms implement high quality innovation strategies. Our findings add to the literature on dynamic managerial capabilities and innovation management in the following ways. First, our study sheds light on the question of how specific professional expertise of the directors matter for all the firms deciding to innovate. Specifically, firms with digital boards may enhance corporate innovation and therefore strengthen their long-term competitiveness. Past research show that the boards provide strategic contributions to the firm (Chatterjee and Wernerfelt, 1991; Golden and Zajac, 2001; Gordon *et al.*, 2000; Valenti and Horner, 2020). Our study adds new supportive evidence that the inclusion of directors able to understand the new technological trends that are impacting business decisions are crucial for corporate innovation. Second, our study provide evidence on the board's configuration to assess the role of corporate governance on corporate innovation activities (e.g., Chen *et al.*, 2015; Cumming and Leung, 2021; Sariol and Abebe, 2017). Furthermore, the results may also be explained by the upper echelons theory which suggests that determined board of directors' characteristics have a direct impact on corporate strategy (e.g., Greiner and Bhambri, 1989; Hambrick and Mason, 1984; Haynes and Hillman, 2010; Herrmann and Nadkarni, 2014; Wu *et al.*, 2021). While most of the upper echelons' research examines the demography, composition, and other characteristics such as the educational background among directors, this study

introduces a new variable of professional background that serves as a mechanism to explain why firms decide to change their strategy by innovating.

2 Theory and hypotheses

We begin our theorizing by reviewing prior research on the antecedents of innovation and by establishing the baseline linkage between board's characteristics and innovation. We then build on these arguments to conceive how board of directors with digital expertise shapes whether observing firms activate innovative strategies. As we will describe, our prediction regarding the effect of the board expertise builds upon research on the dynamic managerial capabilities, suggesting that specific competencies are essential to help firms redeploying and reconfiguring their resource base to sustain a competitive advantage through value-creating strategies (i.e., innovation).

2.1 The executives' influence on innovation

A number of past studies have indicated that individual characteristics and experience represent a relevant antecedent of corporate innovation (e.g., Attah-Boakye *et al.*, 2020; Balkin *et al.*, 2000; Elenkov *et al.*, 2005; Hoffman and Hegarty, 1993; Prasad and Junni, 2016; Zhang *et al.*, 2017). For instance, the functional expertise of top management explains the influence on different innovation decisions like product-market and administrative (Hoffman and Hegarty, 1993). Similarly, the product-market and administrative innovations have been studied in association with specific strategic leadership dynamics (Elenkov *et al.*, 2005). Liu *et al.* (2020) focused on executives with financial backgrounds to demonstrate that they tend to undertake less innovation within the firm; rather, they opt for quick short-term return of financial investments. Also, the cross-country research conducted by Attah-Boakye *et al.* (2020) found that gender representation of the board positively impacts on corporate innovation. The surveys administered by Colder (2000) revealed that senior executives develop more new products in international markets when the knowledge is spread across the organization.

Limited research focused on the relationship between board members and innovation suggested that the diversity in scope of the board (i.e., gender and age) results in higher-quality patents (Cumming and Leung, 2021). The main assertion in the study of Chen *et al.* (2022) is that board structures made up of

different classes of directors are more inclined to increase the number of new trademark and of product-related patents developed.

Consistent with the expectation that CEO characteristics shape corporate strategies, scholars have largely examined the impact of CEOs on innovation. In the computer software industry, the long-tenured CEOs, CEOs with technical education, and CEOs with broad functional background increase the level of innovative exploitative activities rather than explorative (Tabesh *et al.*, 2019). CEOs have generally great power to influence the innovation decisions if their compensation system is based on short-term and long-term indicators (Makri *et al.*, 2006). In fact, this category of CEOs reinforces the invention resonance (i.e., number of citations) and the science harvesting (i.e., number of references in the firm's own patent applications to scientific papers). In a similar vein, in high-technology industries it has been shown that the CEO's short-term and long-term compensations are related to the firm's ability to innovate (Balkin *et al.*, 2000). Instead, the presence of high dispersion in executive pay fosters the negative effects on firm's innovative performance (Amore and Failla, 2020). On the one hand, risk-taking and explorative CEOs represent effective predictors of innovation quantity, quality, and novelty, according to Makri and Scandura (2010). On the other hand, Prasad and Junni (2016) found that transformational and transactional CEOs can both support the organizational innovation. Similarly, Marwaha et al. (2005) surveyed more than 9,300 global business leaders and found that, according to 33% of technology executive, the exploitative activities represent a key driver of growth than the explorative ones. Sariol and Abebe (2017) illustrated the existence of a positive and significant relationship between CEO power and organizational innovation activities; they in fact found that powerful CEOs encourage the introduction of new products. At the same time, cognitive and personal treats have been associated with the CEOs in relation to innovation outcomes. For instance, Zhang *et al.* (2017) provided support that humility and narcissism of the CEO are interactively associated with the innovative culture and the innovative performance. The executive hubris has been studied by Tang *et al.* (2015) who demonstrated that it is positively affected by the firm innovation. Likewise, Galasso and Simcoe (2011) reported that the CEO overconfidence is positively associated with innovation.

Hence, although recent studies demonstrate that corporate directors recognize the need to innovate to stay ahead (Cheng and Groysberg, 2018), on balance the innovation benefits associated with the CEO characteristics outweigh those

resulting from the board's ones so far. Our study addresses this gap by exploring new horizons on the influence that board of directors have on innovation strategies.

2.2 The role of professional experience of the board: dynamic managerial capabilities' perspective

The dynamic managerial capabilities perspective is an influential theoretical framework for understanding how executives develop specific skills and experience to sustain the firm's competitive advantage (Åberg and Torchia, 2020; Adner and Helfat, 2003; Augier and Teece, 2009; Helfat and Martin, 2015; Kor and Mesko, 2013). The three core underpinnings of dynamic managerial capabilities are managerial cognition, managerial social capital, and managerial human capital (Adner and Helfat, 2003). The managerial cognition is associated with beliefs and mental modes that managers develop over time; the managerial social capital is based on the development of their network relationships; the managerial human capital represents the base of knowledge and competencies that managers develop through their prior experience, training, and education (Helfat and Martin, 2015). We focus on the managerial human capital capturing the role of specific professional backgrounds of the board of directors with the aim to understand how certain experience influence the firm's decisions to innovate.

Previous research has largely neglected the role of the board of directors in innovation strategies. For instance, Veltrop *et al.* (2017) provided evidence on the presence of board financial expertise on the directors' social status and influence within the board. In addition, past board experience in environmental sustainability has been studied in association with the firms' ethical behavior (Homroy and Slechten, 2019). The need to develop board expertise to be aligned with the firm risks is examined by Schnatterly *et al.* (2021) who suggested that such alignment results in an improved performance. Accounting, legal, political, and corporate media experience in the board have been investigated by Masud *et al.* (2019) in association with the corporate corruption disclosure. Directors with increasing level of scientific expertise are better able to generate value from research and development investments, according to Cumming and Leung (2021). Finally, despite the study of Wu *et al.* (2021) recently considered the role of chief technology officers in association with the firm's patent application and with the quality of innovation, they limit their analysis to female executive representation.

Building on the dynamic managerial perspective, we suggest that specific resources are useful for the innovation context (Eisenhardt and Martin, 2000; Winter, 2003). We also reason that innovation represents a high degree of change and uncertainty requiring that specific competencies need to be developed to encourage the innovation process (Lee and Kelley, 2008; Makri and Scandura, 2010; Prasad and Junni, 2016). We form this expectation as prior research has pointed to the importance of board expertise "to foster and initiate innovative ideas and strategies" when innovation is central to the firm's survival (Valenti and Horner, 2020, p. 17). Especially, since directors with digital expertise have enough flexibility to address rapid environmental transformations (Lewis, 2020) and because they are particularly confident with new technologies, we believe that when firms appoint at least one director with digital expertise, it will influence the firm's decision to direct more innovation activities. It could be especially true under circumstances of environmental transformations like technological changes when firms are committed to adopt innovation strategies to survive. Thus, there is a need for firms to develop this specific expertise to entirely capture value from innovative changes. The arguments above lead us to predict board of directors with digital expertise will increase the likelihood that firms innovate more. Therefore,

> *Hypothesis (H1). A positive relationship exists between the presence of at least one director with digital expertise in the board and the corporate innovation.*

3 Data and method

3.1 Sample

We studied corporate innovation by 2527 US listed and large firms during 2005–2019. We compiled our data from multiple sources. Data on the digital expertise of the board were automatically collected by using the RStudio software from DEF 14A proxy statements published on SEC EDGAR and were later manually checked via LinkedIn and corporate websites. Financial data came from the Compustat database and board data came from the BoardEx database. Our corporate innovation measurement was based on the number of forward patents' citations gathered from the United States Patent and Trademark Office (USPTO) by using Orbis Intellectual Property.

3.2 Dependent variable: corporate innovation

In line with previous research (Chang and Wu, 2021; Moon *et al.*, 2022; Wu *et al.*, 2021), we collected patent data to generate a measure of corporate innovation since firms spending more on R&D receive more patents (Griliches *et al.*, 1986). We consider the number of forward citations received by all patents in a given year from 2005 to 2019 to capture the quality and influence of innovation; we then use the natural logarithm of each measure to mitigate bias introduced by outliers. We gathered data from the USPTO, the federal agency for granting U.S. patents and registering trademarks.

3.3 Independent variable: digital expertise of the board

We compiled an original database on the creation of digital expertise of the board among 2527 US firms. We refer to the DEF 14A proxy statements published on SEC EDGAR for the identification of specific sentences indicative of the directors' digital experience. By using RStudio, we first downloaded these DEF 14A documents containing common keywords included *chief technology officer, chief technical officer, chief information officer, chief information security officer, chief information technology officer, technology, digital, online, mobile, software, e-commerce*. We then manually checked every sentence contained in the RStudio output to be consistent, and we triangulated board information about each firm using a variety of online sources (e.g., LinkedIn profiles and corporate websites) to confirm the directors' digital experience. For each of the firms from 2005, we searched whether each director has held a digital position at least once in his/her professional career. Our independent variable was measured by the lagged percentage of directors with digital expertise on the total directors (Whitler *et al.*, 2018).

3.4 Controls

Since availability of resources may influence the likelihood that a firm invest in innovation, we controlled for the log-transformed *firm slack*, measured as the ratio between current assets of the firm and its current liabilities in the prior year. We used the lagged measured of total assets to control for the *firm size* (log-transformed). We then measured the *firm age* as difference between the year of reference and the incorporation date, in addition to the *firm performance*

measured as the return on assets (lagged). We used the ratio between debt and equity to account for the *firm leverage*. These firm-level variables are gathered from the Compustat database.

To control for the total number of directors within the firm in the year of reference, we included the *board size* variable gaining information from BoardEx. The same database has been used to collect data on the *share of independent directors*, measured as the ration between total number of independent directors on total number of directors in the reference year (lagged).

We finally use the factor variable related to the *year* in which each firm is observed.

4 Preliminary results and Discussion

The digital era has brought about significant changes in the business world, forcing firms to adopt innovative strategies to remain competitive. As such, disruptive transformations like the digital one represents a crucial aspect to consider for corporate strategy. The ability to navigate complex and rapidly evolving scenarios is critical for firms aiming at leveraging on innovation and at achieving sustainable growth. In this context, the board plays a crucial role in shaping the strategic direction of the firms and in ensuring that they remain competitive in the digital landscape.

In this study, we conducted a panel data analysis and preliminary results show that the effect of digital expertise of the board on quality of corporate innovation is positive and significant, exhibiting that the presence of directors with digital expertise encourages firms to consider innovation as a top strategic challenge. To check for robustness, we measure the lagged percentage of digital executives on the total number of directors as independent variable, and the preliminary outcomes support our previous results.

There are several reasons why board of directors with digital expertise can positively impact the quality of innovation. In recent years the role of digital expertise within the board has become increasingly sought-after and the digital knowledge is increasingly integrated into every aspect of the business. Thanks to these types of expertise, the board of directors can provide valuable insights into emerging technologies to drive innovation. Moreover, board of directors with digital expertise can help to foster a culture of innovation within the firm. In fact, they can provide guidance on how to craft an environment that encourages

creativity, experimentation, and risk-taking, which are essential for successful and high-quality innovation.

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Sustainability in Family Firms: A Structured Literature Review

Veronica Procacci

Università La Sapienza
Facoltà di Economia
Via Del Castro Laurenziano, 9 – 00161 Roma

Abstract

The family firm is a type of firm in which family owners "exercise substantial influence on the firm's affairs".
Family businesses dominate the economic landscape. According to the latest statistics from the Family Firm Institute, family firms account for two thirds of all businesses around the world, generate around 70-90 percent of annual global GDP, and create 50-80 percent of jobs in the majority of countries worldwide.
Sustainability practices are critical for family firms, as they relate directly to the continuity of the business and relationships with important stakeholders, such as members of the local community. evertheless, not all family firms wish to adopt sustainability practices.
The purpose of this paper is to identify and analyse the main areas of research related to sustainability practices in family firms.
The study proposed here is part of an ongoing research project in the field of family business studies and is also part of a broader interdisciplinary investigation.
In order to identify the topics dealt with and the investigation methods used, a structured literature review (SLR) was carried out. Specifically, 87 international contributions on the selected SCOPUS database were analysed.
This paper stems from the need to provide an overview of varied literature on the topic in order to understand the different approaches to sustainability that family businesses have. The literature review shows that the gaps in knowledge about family businesses' (FF) approach to socially responsible initiatives persist. FFs present unique perspectives on socially responsible behaviour, as they recognise an undoubted priority to actions related to emotions and goals such as reputation, identity, image and environmental performance.

Keywords – Family firms, sustainability, Corporate social responsibility

Paper type - Literature review, Academic Research Paper

1 Introduction

A family business is a type of enterprise in which family owners 'exercise substantial influence over the business' (Gómez-Mejía, Cruz, Berrone, & De Castro, 2011).

Family firms involve both SMEs and large companies and dominate the international business landscape. According to statistics from the Family Firm Institute, family firms account for two-thirds of all businesses worldwide, generate around 70-90% of annual global GDP and create 50-80% of jobs in most countries around the world (Family Firm Institute, 2017).

Although the importance of family businesses is even greater in Europe (Botero et al., 2015), they contribute significantly to the growth of the economies of South and East Asia, Latin America and Africa (Tharawat Magazine, 2014).

Their economic impact is clear from their great long-term stability and from their high level of commitment to the community in which they operate. The families of FFs demonstrate the responsibility they feel as business owners, as the firms represent their family values.

Similarly, there is a growing focus by companies of all sizes on sustainability and thus socially responsible actions.

In fact, investments in sustainability practices worldwide are steadily increasing and have reached USD 600 billion (Paul, 2019).

Studies indicate that sustainable development can be a source of success and innovation that is profitable for companies (Broccardo et al., 2019) and that companies with sustainability practices have a competitive superiority over others that do not have them (Adomako et al., 2019).

In particular, internal sustainability practices (pollution prevention and green supply chain management) help companies reduce environmental costs and risks, thus leading to wealth creation.

External sustainability practices (green product development), on the other hand, enable companies to meet the expectations of external stakeholders, including customers, suppliers, NGOs, regulators and communities, thereby enhancing the legitimacy and reputation of the company (Hart and Milstein, 2003).

Businesses adopt responsible practices not only to build social legitimacy, but also to adapt to the environment in which they operate, which may favour or limit their continued growth (Goll & Rasheed, 2004).

The growing trend of sustainability practices has boosted the need to define how to implement FFs. They are influenced by a number of intrinsic factors, and since the FFs' universe is very heterogeneous, so is their approach to sustainability (Caputo et al., 2017).

Sustainability issues in FF require research because of the importance of such practices and the impact they will have on companies' reputations and profits.

The literature on sustainability is vast and the topics from are numerous. Given the specific characteristics of FF, theoretical support for FF sustainability studies is usually based on five theories: Socio Emotional Wealth (SEW) Theory, Corporate Social Responsibility, Stakeholder Theory, Resource-Based View (RBV) and Stewardship Theory.

The literature review proposed here was conducted with an analysis of studies relating to three key themes: 1. the succession process, 2. social disclosure in family firms 3. correlation between family governance and socially sustainable practices, the predominant theme, 4. sustainable innovation in family firms. The last theme showed little results.

By adopting a structured literature review (SLR) methodology (Massaro et al., 2016; Paoloni and Demartini, 2016; Paoloni et al, 2020), and following the suggestions defined in the protocol, this article attempts to answer the following research questions:

RQ1. How is research in the literature developing the topic of sustainability in family businesses?

RQ2. What are the main foci of analysis in the extant literature?

RQ3. What are the possible future research areas?

The following article is organised as follows. Section 2 describes the research methodology used for the analysis, section 3 presents the results obtained from the study of the SLR. Section 4 discusses the results, while section 5 provides concluding remarks and finally section 6 theoretical and practical implication.

2 Research methodology

In this work, the SLR method was used to analyze the literature on sustainability in family firms, a method already used by Paoloni and Demartini (2016). This type of literature classification is widely used among business economics academics.

In essence, what distinguishes an SLR from an analysis of the conventional literature is that we follow a specific methodology that selects and evaluates the contributions and analyzes and summarizes the data to obtain results with greater transparency, completeness and reproducibility of analysis (Tranfield et al., 2003; Denyer and Tranfield, 2009; Littell et al., 2008).

SLR is used by researchers to map and assess existing intellectual territory to identify

future research needs (Dixon-Woods, 2011, p. 331).

This approach is used as the aim of the following work is to provide an overview of the vast and varied literature on the topic in order to discover under-researched topics and methods, thus nurturing the development of new areas of knowledge and research approaches (Massaro et al., 2016).

The database used by the Authors to extract the information is SCOPUS because it is widely used and the largest available database for the multidisciplinary scientific literature (De Moya-Anegon et al., 2007).

The research was conducted on 12 March 2023. The authors identified specific clear words specifically the Scopus query used was the following: ("family businesses" and "sustainability"). The authors limited the search to 'Paper title', 'Abstract' and 'Keywords' to avoid extracting papers unrelated to the research objective.

This search yielded 165 papers.

Filter by subject area was applied to limit the search to documents related to Business, Management and Accounting and Economics, Econometrics and Finance. Therefore, only articles that reached the last stage of publication and were written in English were examined. Specifically, 87 international contributions were analyzed.

Figure 1 shows the process used to identify the eligible research.

The limited number of contributions related to the topic under study prompted the authors to investigate the existing literature in order to outline possible future research alternatives.

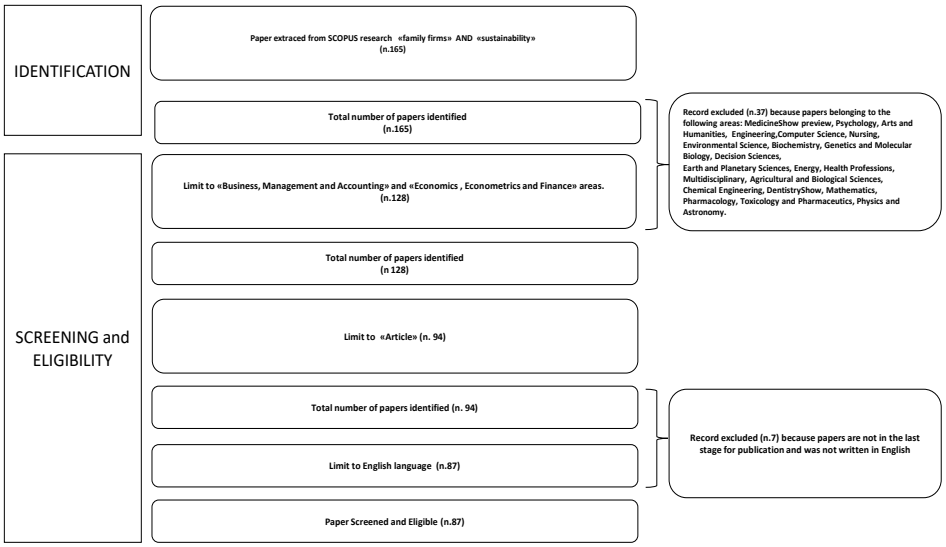

Figure 1. The procedure for selecting the eligible papers

2.1 Definition of the analytical framework

About the framework the authors decided to use method as proposed by Paoloni and Demartini (2016).

We made several adjustments to fit categories and their characteristics to our sample and to make them compliant and relevant to our RQs.

This allowed the analytical framework to be defined, which was helpful in distinguishing units of analysis within selected documents as separate items. (Yin, 2014)

After reviewing and classifying the articles in the most consistent way with the research theme and having identified the most consistent classifications referring to the literature and consequently to the adjustments made with the continuation of the work, the taxonomy of the categories emerging from this process are presented list below (analytical framework).

The categories were selected after reading the titles, abstracts and keywords of the articles.

- A - Article focus
    - A1 – Generational succession process
    - A2 – Sustainability reporting in family firms
    - A3 – Correlation between family governance and socially sustainable activities

    - A4 – Sustainable innovation in family businesses
    - A5 – Other
- B - Research methods
    - B1 – Literature analysis
    - B2 – Qualitative
    - B3 – Quantitative
    - B4 – Mixed Method
- C – Geographical area
    - C1 – Comparative study
    - C2 – America
    - C3 – Europe
    - C4 – Asia
    - C5 – Africa and Oceania

The purpose of the category "article focus" is to identify the specific focus of articles in order to gain insights into which topics are of continuing interest to scholars or otherwise (Paoloni and Demartini, 2016).

They are outlined below:

A1 Generational succession process: includes all works dealing with the topic of generational succession in family businesses, in detail the sustainability of family businesses over time and the changes brought about by new generations.

A2 Sustainability reporting in family firms: here are included all papers dealing with the topic of sustainable reporting in family businesses and specifically the credibility of these reports compared to those prepared by non-family businesses.

A3 Correlation between family governance and socially sustainable activities: includes articles on the correlation between family ownership and the propensity to engage in sustainable business activities.

A4 Sustainable innovation in family businesses: includes contributions on innovation in family businesses, in detail analysing the difference in the approach to innovation of family businesses compared to non-family businesses.

A5 Other: here are collected all articles that are not related to the previous article focuses. In particular, they are researches concerning specific working conditions not related to gender inequalities.

In relation to the category search method, the authors distinguished the following methodologies:

B1 *Literature analysis:* SLR results dedicated to the review of existing literature.

B2 Qualitative research: analysis carried out using case studies, experiments, content analysis, surveys through interviews, focus groups, etc.

B3 Quantitative analysis: structured method to collect and analyse data obtained from different sources. It involves the use of statistical, mathematical and computational tools. B4 *Research mix:* including both qualitative and quantitative methodology.

The last classification is related to geographical area. With reference to geographical origin, articles were classified not according to the location of the research but according to the origin of the author.

tarting from the taxonomy quoted by Paoloni and Demartini (2016) a smaller number of geographical areas were considered as follows: C1 Mixed (authors with affiliations from different geographical areas), C2 America (Canada, USA, Brazil, Colombia and Argentine), C3 Europe, Switzerland and UK (Austria, Belgium, Denmark, Iceland, Ireland, Finland, France, Germany, The Netherlands, Norway, Poland, Sweden, Greece, Italy, Portugal, Spain, and Turkey), C4 Asia (China, Japan, Korea, Singapore, India), C5 Africa and Oceania (South Africa, Australia and New Zealand).

3 Results

For each research study, defined as eligible, the authors read the title, abstract and keywords to ensure they were consistent with the research objectives.

3.1 Research focus

The authors analysed the documents and divided the research studies according to the topics covered. Figure 2 shows the results obtained over the period 1999 to 2023.

The main focus of the researchers was A3, *Correlation between family governance and socially sustainable activities*, with 48 documents out of 87 analysed followed by A1, *Generational succession process*, with 16 documents, than A2 *Sustainability reporting in family firms*, with 6 documents out of 87 related to the topic. 5 documents were categorised in the section A4 *Sustainable innovation in family business,* and finally 12 documents were included in category A5 *Other*, residual category, where we find contributions that could not be included in any of the previous.

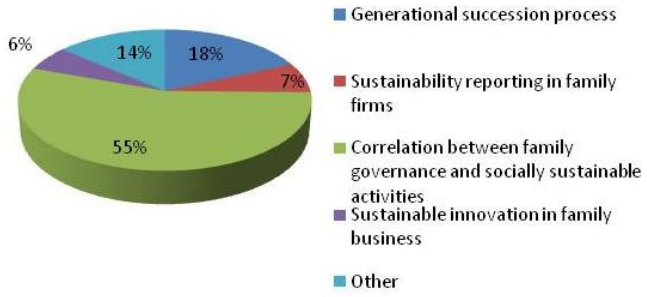

Figure 2. Times series articles focus evolution

3.2 Research method

The most commonly used research method was B3 (Quantitative research) with 45 papers out of 87 analysed, followed by B2 (Qualitative research) with 38 papers, B1 (Literature analysis) with 3 papers and finally B4 (Research mix) with 1 paper.

The results explained here are summarised in figure 3.

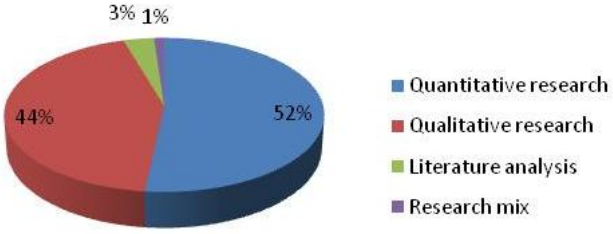

Figure 3. Times series research method evolution

3.3 Geographical area of authors' affiliations

Most of the documents analyzed were written by from areas C1 (Mixed) with 32 contributions out of 87, here are enclosed contributions written by authors with affiliations from different geographical areas, followed by C3 (Europe, Switzerland and UK) with 22 papers, than C2 (America) with 18 documents, followed by C4 (Asia) with 11 documents and lastly C5 (Africa and Oceania) with 4 contributions. All results are shown in Figure 4.

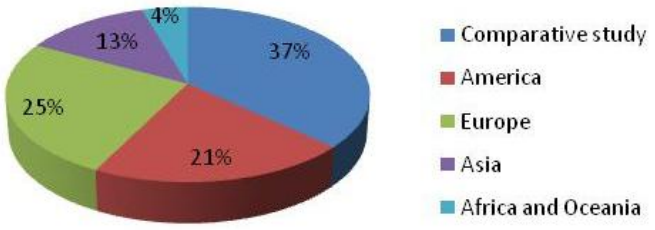

Figure 4. Representation of the geographical area of authors by year of publication

4 Discussion

This section analyses the main contributions with reference to the identified analysis focuses. The aim is to answer research question RQ1, namely how the literature is developing the topic of sustainability in family businesses, and research question RQ2.

The article focus with the highest number of contributions is A3, *Correlation between family governance and socially sustainable activities,* probably because ownership structure is one of the most relevant dimensions to explain differences in environmental performance between firms (Dou, Su, & Wang, 2017; Lamb & Butler, 2016).

A common belief is that the presence of family influence affects the firm's strategic behavior (Chua et al., 1999; De Massis et al., 2021; Xi et al., 2015; Yu et al., 2020), and thus its sustainability practices.

Several literature reviews contain inconsistent and sometimes contradictory findings (e.g. Van Gils, Dibrell, Neubaum, & Craig, 2014) on the relationship between family ownership and environmental practices and performance. The underlying perspective of family business studies is that family businesses behave differently from non-family businesses because owners aim to shape and pursue the vision of the business. Family ownership changes the goals of the firm (Basco, 2017), thus changing the reference point for strategic decisions (Cennamo, Berrone, Cruz, & Gomez-Mejia, 2012), such as environment-related practices (Doluca, Wagner, & Block, 2018; Sharma & Sharma, 2011).

Given the specific characteristics of FF, theoretical support for FF sustainability studies is usually based on five theories: Socio Emotional Wealth (SEW) Theory, Corporate Social Responsibility, Stakeholder Theory, Resource-Based View (RBV) and Stewardship Theory.

Relevant is the contribution of (García-Sánchez et al., 2020), the authors in their analysis of 956 international companies for the period 2006-2014 confirm that family businesses, under difficult environmental conditions, show a greater commitment to CSR and are more likely to direct their CSR activities towards both stakeholder groups in order to preserve their emotional and social endowments. They are likely to avoid any irresponsible behaviour that could damage their family name and make their stakeholders unhappy, which is crucial to bring valuable resources and ensure their survival in difficult times. These findings contribute to the research on CSR in family businesses and respond to the calls of Dyer and Whetten (2006), Berrone et al. (2012) and Cennamo et al. (2012), in particular.

The opposite view is the one presented by Rees and Radionova 2015, the authors in their study found that listed family firms have worse environmental performance than listed non-family firms and argued that family firms are more concerned about their wealth than non-family firms. In particular, the authors hypothesised that family shareholders may impose their interests in the organisation.

The second article focus with a larger number of contributions is A1, Generational succession process, in fact the main reason for the closure of family businesses is the problems in succession preparation (Handler, 1994). Succession is a multi-dimensional process through which leadership shifts from one generation to the next (Sharma et al., 2001). Due to the difficulties in managing the highly complex and emotional process (Matthews et al., 1999), it has been difficult to establish generalizable theories of succession.

A successor's managerial ability could be said to be one of the most critical factors influencing succession. Especially when an incumbent CEO selects a successor, the successor's managerial ability could be an essential criterion. It also significantly affects the company's performance during and after the succession process.

In a study by Kang and Lee (2009), business competence was defined as a complex of skills, knowledge, and behavioral modalities to affect successful succession. As a result, business competence had a positive and significant effect on succession effectiveness. Education and training are crucial factors that form the successor's managerial ability, and the factors could possibly affect succession (Kim & Han, 2017).

On the other hand, the means of succession in a family business are different. Even the succession is not finished after the succession. It means that a long-term plan and the preparation of succession are necessary for a successful succession. The plan is also needed in various areas, and family members and nonfamily members should be included.

A literature review with reference to the succession process within family businesses reveals another theme: with the second/third generation there is an increase in investment in social and environmental initiatives. Mullen 2018, in his contribution, he explains that the underlying reason for this evidence is that when the company passes from one generation to the next, the concern to maintain and further strengthen the relationship with the company increases in importance. Consequently, the company invests more in social and environmental initiatives to strengthen its reputation in the next generation.

In article focus A2 we find contributions addressing the topic of sustainability reporting in family businesses.

Corporate social responsibility (CSR) reporting is defined as the process of communicating the social and environmental actions of organisations to particular interest groups within society and to society at large (Campbell 2004; Gamerschlag et al. 2011; Gray et al. 1987).

The literature on CSR reporting has increased considerably in recent years, in parallel with the development of CSR practices, assuming that this implies that the company is responsible for its actions (Perrini 2005).

Specifically, the contributions we study analyze the credibility of corporate communication in family businesses, compared to non-family businesses, in the context of voluntary sustainability reporting.

Part of the literature argues that family businesses suffer from a credibility disadvantage with regard to their sustainability reporting efforts from the perspective of external stakeholders. This phenomenon is referred to as the 'credibility gap'.

It is defined as stakeholders' lacking of trust in the ability or intention of the reporting company (Dando and Swift 2003). It causes stakeholders to have little confidence in the authenticity of company claims in the report. The voluntary nature of sustainability reporting further reinforces this credibility gap. A company can strategically choose what to disclose about its actual behavior, especially unethical behavior (Wang and Li 2016).

However, this result is in stark contrast to the other part of the literature which argues instead that there is greater trust attributed by external stakeholders to family businesses. This depends to a large extent on the man model (Corbetta & Salvato, 2004) that stakeholders attribute to family businesses and their respective owner families.

According to the agency theoretical perspective, family businesses should have a credibility disadvantage. The family owner possesses privileged information about the company that could be used to opportunistically exploit external stakeholders and deprive minority owners (Morck and Yeung, 2003, Schulze et al., 2001, Young et al., 2008).

Opposed to this view is the stewardship theory, which assumes that individuals are characterised by a more organisationally favourable, collectivistic and intrinsic motivation (Davis, Schoorman, & Donaldson, 1997).

In detail in the work of (Stutz et al., 2022) it emerges that neither family nor non-family businesses suffer from a greater credibility gap when it comes to sustainability reporting as judged by external stakeholders.

However, their extensions of the original study reveal that when family businesses are perceived as such, they have a credibility advantage over non-family businesses. This effect is completely mediated by the perceived benevolence of stakeholders.

Furthermore, the authors show that this credibility advantage translates into positive stakeholder behaviour in the form of increased purchase intentions (for customers) and application intentions (for job seekers).

Undoubtedly, socio-emotional wealth and emotional assets play a key role within family businesses.

In fact (Dominguez et al, 2021) Through empirically conducted analysis of an international sample of companies, they argue that decisions in family businesses are made according to accumulated affective wealth or socio-emotional wealth aimed at maintaining ownership and control of the company and passing it on to future generations.

This decision-making framework leads these companies to make decisions to protect socio-emotional wealth, finding in CSR a sustainable growth strategy that favours the image and reputation of the company and the family. In this sense, the authors believe that these companies will be less prone to greenwashing practices due to the risks it may pose to their image and legacy, opting for a more meaningful coupling between what they do and what they say.

Lastly, article focus A4, *Sustainable innovation in family businesses*, with a rather small number of contributions.

Relevant is the study of Dangelico et al., 2019, in which the authors question what are the differences and commonalities between family and non-family businesses regarding their approach to green Innovation.

The authors point out that the main differences between the two categories of companies concern the antecedents of green innovation, and and how it is conceived, whereas green innovation in itself (characteristics, process characteristics, and challenges) and its outcomes are not influenced by the nature of the firm.

In particular, family businesses are mainly driven from the perspective of longer-term benefits (such as quality improvement, better image and reputation, and market share growth) and pressure from internal stakeholders (such as the family and future generations), and this leads them to conceive green innovation primarily as an opportunity. On the other hand, non-family enterprises are driven by short-term benefits (such as maintaining market share and customer demand satisfaction) and the pressure exerted by both Internal and external stakeholders, leading them to see green innovation primarily or initially as a necessity to satisfy external actors.

Innovation has become a critical factor in achieving sustainable growth through energy efficiency improvement and energy intensity efficacy at both the micro and macro levels.

Innovations at the micro (firm) and macro (country) levels support sustainability in the long run by producing more output while causing less natural resource depletion.

The innovation and sustainability link at the micro level exhibits a family-firm (ownership) effect and an innovation-technology impact. (Kao and Huang, 2019) show that technology-related innovations have a primary role in supporting sustainable growth.

On the macro level, (Fagerberg et al., 2010) show a clear correlation between innovation activity and the state of development. The higher the GDP per capita is, the higher the share of companies participating in innovation activities.

Skare et Porada-Rochon 20220, in their study they point out a gap in the literature on the micro level role of family firms in innovation-driven sustainable development. With their contribution they therefore conduct an empirical analysis to fill this gap. This study finds that the family firm effect has an essential impact

on sustainability related to technological innovations. Technological innovations demand significant financial resources for research and development (R&D). Necessary financial resources for R&D investments are less available to family firms. Therefore, countries with a larger share of non-family firms heavily investing in technological innovation will achieve higher sustainability. As this study shows, , technological innovation in non-family firms promotes an average increase of 1% per%age point increase in innovation more to family firms. This is the family firm effect. The same family firm effect holds for non-technology-related innovation. Firms' in-house-driven innovation investments in intangible assets such as advertising, market research, and branding (ADV) purchased organizational capital (POC), vocational training (VT), and own-account organizational capital (OOC). Family firms investing in these types of innovations contribute less to sustainability than nonfamily firms. The family firm effect is not as strong as in the case of technological innovation but is still present.

5 Conclusions and future perspectives

The analysis shows that the topics of the correlation between family-type governance and sustainable practices and the succession process in family businesses have become increasingly prevalent in the literature, involving a growing number of research articles, with a consequent increase in the number of interconnected analyses on these topics.

With regard to RQ1 (How is the research in the literature on the topic of sustainability in family businesses developing), this has been a fairly discussed topic since the early 2000s. The last five years have seen a small increase in contributions on the topic.

The increasing media attention on the topic of sustainability and the relevance of family businesses internationally have probably stimulated more studies on the topic.

The literature review shows that the topic of sustainability can be analysed from different perspectives. It is clear that, since the family owner strongly identifies with the business, is motivated to ensure its long-term survival and tends to be embedded in its socio-economic context (Corbetta and Salvato, 2004, Gómez-Mejía et al., 2011, Le Breton-Miller et al., 2011, Zellweger et al., 2013), it will exhibit a distinct management behaviour compared to non-family businesses, and thus also approach sustainability.

Regarding RQ2 (What are the main points of analysis in the existing literature?), the largest number of studies is related to focus A3 (Correlation between family governance and socially sustainable activities) with rather mixed results on the topic. From the results of the present anilysis A1 (Generational succession process) is another focus on which numerous researches have dwelt, mainly addressing the increase of investments in social and environmental initiatives with the second and third generation. In particular, it emerges that the reason behind such an increase in sustainable practices can be attributed to the concern of ownership to maintain and strengthen its reputation (Mullen 2018).

Numerous researches have also addressed the issue of the successor's managerial skills in the succession phase, which can be considered one of the most critical factors influencing succession.

Other widely discussed topics, in order of number of contributions, are A2 (sustainability reporting in family businesses) and finally A4 (Sustainable innovation in family businesses), respectively.

With reference to the latest RQ3 research question (what are the possible future research areas?), the literature analysis has generated few contributions on the topic of sustainable innovation in family businesses. It might therefore be interesting to analyse, as an idea for future research, how family businesses raise capital to invest in innovative activities and what sustainable innovations these companies implement, especially by small and medium-sized family businesses.

Finally, an interesting question could be to carry out the same structured analysis of the literature with reference to the theme of internationalization and digitalization, to understand the points of contact between the three themes analyzed (sustainability, internationalisation and digitisation) in the context of family businesses.

6 Theoretical and practical implication

A limitation of this research is the use of a manual approach because it is more convenient and flexible. Moreover, the classification that the authors report involves the introduction of subjective parameters on the evaluation of the results that we have decried. Another limitation of the work is represented by the consultation of only one database (SCOPUS) for the collection of the analysed articles. In the future, it will be possible to use other databases (Google Scholar or JSTOR) and replicate the SLR protocol adopted by this study.

Finally, by performing searches based only on titles, keywords and abstracts, we may have overlooked some relevant information needed to perform a complete classification according to our chosen analytical framework. For instance, in some cases, abstracts do not always provide details on the methodology applied by the authors, if not summary and partial information.

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The Impact of Smart Working on Organization Performance: The Mediating Role of Digital Leadership

Luigi Jesus Basile

Department of Mechanic, Mathematic and Management
Polytechnic of Bari
200, Via Re David, 70125 Bari Italy

Nunzia Carbonara*

Department of Mechanic, Mathematic and Management
Polytechnic of Bari
200, Via Re David, 70125 Bari Italy

**Corresponding author*

Abstract

The development and diffusion of digital technologies (especially those supporting communication, collaboration and social networking), along with the pervasive dissemination of powerful and easy-to-use mobile devices, may encourage organisations to implement Smart Working (SW). The previous research suggests that an effective SW implementation is enabled by the availability of a certain set of resources, namely advanced ICT infrastructure and digital technologies, employees' digital skills and acceptance, and a trust-based organizational culture and managerial style. Despite this, the existing studies neither empirically determine the role of enabling resources for an effective SW implementation nor explain the interplay of different SW enablers in the improvement of organization performance. This study investigates through an empirical study the relationship between the SW enabling resources and the organization performance. Furthermore, this study aims at analysing the mediating role of digital leadership on the relationship between the SW enabling resources and organization performance.

Keywords – Smart Working, Digital Leadership, organization Performance

Paper type – Academic Research Paper

1 Introduction

The development and diffusion of digital technologies (especially those supporting communication, collaboration and social networking), along with the pervasive dissemination of powerful and easy-to-use mobile devices, may encourage organisations to implement Smart Working (SW) (Ahuja et al., 2007). In this regard, the necessity caused by the Covid-19 pandemic made the adoption of digital technologies along with the implementation of SW faster and widespread (Baudier et al., 2023). Looking at the post-pandemic world, researchers and practitioners are questioning about the future of SW and whether it will be adopted by companies as an established successful practice. Indeed, an essential part of the "new normal" after the Covid-19 pandemic will be a revision of the working methods (Bonacini et al., 2021) to employ an effective combination of information technologies, computer networks, and mobile devices.

Several studies investigated SW implementation during the pandemic (e.g., Bonacini et al., 2021; Fana et al., 2020; Ipsen et al., 2021). Most of them focused on the identification of benefits, drawbacks as well as implementation drivers. As to the latter aspect, many scholars pointed out a new paradigm shift that "is being driven by extreme changes in approaches to work, work cultures, business architectures, decision making, communications, and collaboration" (Boorsma & Mitchell, 2011, p. 2). Others referred to evolutionary changes in work and management practices that are enabled by technological advances and that foster both organizational agility and new workforce expectations (e.g., Bednar & Welch, 2020; McEwan, 2016). Overall, what emerges from the different contributions are the enabling resources for an effective SW implementation. There is no doubt that a SW successful implementation requires changes in the organizational culture and managerial practices, Information and Communication Technology-based solutions, and specific employees' characteristics and behaviours, e.g. perception, motivation, flexibility, digital skills and capabilities (Berghaus et al., 2015; Reyt & Wiesenfeld, 2015; Vanajan et al., 2020).

Few studies investigated whether and to what extent SW impacts on organization performance. Some evidence suggests that when implemented, SW not only reduces infrastructure costs but also increases the workforce's overall productivity (Barrero et al., 2021; Bolisani et al., 2020). Others arrive to opposite results, proving that expected benefits or performance brought by systems including SW are not satisfactory. In other words, introducing SW systems or

building ICT-based infrastructure does not produce performance immediately (Sasidharan et al., 2012).

Only Ko et al. (2021) identify the antecedents of SW appropriation and examine what effects the appropriation of SW has on task performance, whereas Carbonara et al. (2022) conduct an empirical study to investigate whether and under which conditions companies that adopted SW during the Covid-19 pandemic improved their performance. However, as far as we know, no other researchers have explained the interplay of the different enabling resources for SW implementation in the improvement of organization performance. Understanding the impact on performance is important because SW requires companies to invest to acquire tangible and intangible resources, such as technologies, workspaces, HR management systems, competence and training, and such investments should be offset with appropriate benefits. Furthermore, establishing the benefits of SW for the organization will enhance the confidence and commitment of managers in this new paradigm of work (i.e., smart working) and its implementation. Therefore, this study aims at investigating through an empirical study the relationship between the SW enabling resources and the organization performance.

Furthermore, this study argues that the relationship between the SW enabling resources and organization performance is mediated by a well-established digital leadership that is a combination of transformation leadership and digital technologies, i.e., the ability of digital leaders to identify and realize opportunities to create value through the effective, efficient, and acceptable use of digital technologies (Waal et al., 2016). It is widely recognized that SW involves more than just the mere implementation of technological resources, existing studies have addressed the necessity of reskilling human resources, changing organizational culture and management practices, but also adopting a new breed of digital leaders to guide organizations towards an effective implementation of SW, and more, in general, the digital transformation (Guinan et al., 2019; Hensellek, 2020).

Despite the booming interest in digital leadership as a unique capability for implementing SW in companies and dealing with digital transformation, no other studies have empirically explored the impact of SW on organization performance through the establishment of digital leadership. Therefore, to explore these relationships, we developed a conceptual framework based on the resource based view (RBV) theory since it may provide a solid basis for identifying and assessing

the significance of all relevant resources and capabilities to ensure organizational performance. The conceptual framework was empirically tested using structural equation modelling on survey data of 209 employees that experienced SW in different Italian public companies.

2 Literature review

2.1. Smart working enabling resources

In the last few years, SW is catching a growing attention from both practitioners and academics. Technological issues represented the focus area of prior studies on SW, which mainly explained the effectiveness of SW as a result of ICT developments (Sørensen et al., 2005; Koh et al., 2014). In this perspective, the use of SW refers to the application of new technologies and systems to carry out tasks, thus, ease of using ICT services that make possible SW is required. In other words, employees are more likely to use SW when relevant technologies and systems provide services with greater accessibility and ease of use (Agarwal & Karahanna, 2000; Venkatesh & Davis, 1996). The previous research thus confirmed that SW is enabled by advanced ICT infrastructure and digital technologies (Coenen & Kok, 2014; Corso et al., 2011; Dornelles et al., 2022), although a successful implementation of SW does not refer to the mere use of ICT tools to provide remote work or to the mere digitization of work processes (Bednar & Welch, 2020). An effective SW requires the parallel development of a "digital culture" (Miller, 2011) that presupposes a virtuous, conscious, and critical use of such tools.

Along with technological factors enabling SW, previous research explored the role of employees and organizations' characteristics as well as of the managerial practices for an effective SW implementation (Chandola et al., 2019; Peretz et al., 2018). Boorsma and Mitchell (2011) state that the term 'smart working' has been used to describe an evolutionary change taking place over a number of different dimensions in the world of work. The scholars also highlight that SW requires 'changes in approaches to work, work cultures, business architectures, premises, decision making, communications, and collaboration' (2011, p.2). There has been a decline in the importance of place in work activities, greater scope for collaboration, employee autonomy and talent management, and an emphasis on innovation (Hamel & Breen, 2007). Lake (2013) highlights flexibility as a key

feature of new, smart working practices. However, the recent multidisciplinary studies on SW recognize that flexibility and disappearance of place are only one feature of smart working. Empirical and theoretical studies, as well as literature reviews, offer relevant insights to better understand this new approach to organizing work and identify the key drivers for an effective SW implementation (Dahlstrom, 2013; Overbey, 2013; Malik et al., 2016; Birkinshaw et al., 2008; Elsbach & Pratt, 2007; Mann, 2012; Reyt & Wiesenfeld, 2015). The drivers include managerial practices, employees' personalities, organizational structure and policy, work digitization and suitable Information and Communication Technology-based solutions, support and training practices for workers.

The implementation of SW requires adequate management policies with particular attention to the reorganization of work and personnel management (Gastaldi et al., 2014; Rapisarda et al., 2021). It would be necessary for organizations to adopt better and more effective human resource management (HRM) practices, e.g. more inclusive and differentiated approaches to support employees so as to better balance work and private life (Marino & Capone, 2021).

Furthermore, workers must be adequately trained and have the technological resources needed to perform well (Manuti et al., 2020). The survey conducted by Barbieri et al. (2021) on smart working during the pandemic demonstrated that workload and social isolation, perceived organizational support, and commitment to organizational change have affected workers' quality of life and their performance during the pandemic. New practices of HRM needed to be implemented in order to reinforce the workers' engagement when the work methods change, motivate them to adopt proactive behaviors and positive attitudes, and achieve results in line with the expectations of the organization (Decastri et al., 2019).

To sum up, the previous research suggests that an effective SW implementation is enabled by the availability of a certain set of resources and capabilities, namely advanced ICT infrastructure and digital technologies (Corso et al., 2011; Kim et al., 2018); employees' digital skills and acceptance (Sung, 2013); a trust-based organizational culture and managerial style (Vanajan et al., 2020; Iannotta et al., 2020; Mann, 2012). Availability and usage of suitable ICT-based solutions (Technology), an employees' aptitude and skills to SW (People), as well as changes in the organizational culture, new managerial and HRM practices (Culture) are the key enabling factors that contribute to implement an effective SW. However, the existing studies neither empirically determine the role of each

factor in the effective implementation of SW nor explain the interplay of different SW enablers in the improvement of organization performance, which is a research gap that needs to be addressed.

2.2. Digital leadership

In order to fully exploit the opportunities offered by the inclusion of digital technologies into an organization, a true digital transformation process is required, which includes the redesign of the organizational structure, a profound change of the organizational culture, the alignment of business strategy, new capabilities and competences of workers (Oberer & Erkollar, 2018; Wasono & Furinto, 2018; Mihardjo et al., 2019). To achieve this result, a total organizational commitment is required (Miller, 2016), which is driven by an appropriate leadership style (Kohnke, 2017), namely the digital leadership.

Beyond the key characteristics required to transformational leaders, namely interpersonal, technical, & decision-making skills, individual behaviors and personal traits (DeRue & Ashford, 2010; Judge et al., 2001; Santoso et al., 2019), digital leaders must possess a set of capabilities to identify and realize opportunities to create value through the effective, efficient, and acceptable use of digital technologies (De Waal et al., 2016). Despite digital leadership is currently considered a key ability to support companies in advancing the digital transformation process, its role in the effective implementation of SW, which is part of the digital transformation process of organizations, seems to be overlooked by empirical studies in the academic literature.

2.3. The Resource based view theory

The Resource Based View (RBV) theory explains that organisations can achieve sustainable competitive advantage by properly creating bundles of strategic and dissimilar resources and/or capabilities (Barney, 2001). As a matter of fact, RBV is a principal paradigm for theoretically and empirically assessing the relationship between organizational resources and organizational performance, and, therefore, it allows one to understand how firms can improve their performance (Brandon-Jones et al., 2014; Chahal et al., 2020; Gupta et al., 2018; Kraaijenbrink et al., 2010). Given that the main objective of this study is to investigate the relationship between the SW enabling resources and the organization

performance and to explore if the presence of digital leadership can explain the effect of the SW enabling resources on the organization performance, the choice of RBV as a theoretical framework for this study seems appropriate. This is consistent with Wade & Hulland (2004), who argue that RBV not only provides a useful means to assess the strategic value of organizational resources but also lays out a clear association between resources and capabilities as an independent variable and firm performance as a dependent variable.

Even though the RBV theory has been criticized for the lack of clarity in distinguishing the terms resources and capabilities (Kraaijenbrink et al., 2010), the literature uses the term resources referring to any assets owned and controlled by the firm (Amit & Schoemaker, 1993; Aragón-Correa & Sharma, 2003; Barney, 2001), whereas the term capability is used to indicate a bundle of resources or, in other words, the ability to effectively combine and utilise the resources to achieve a desired outcome (Huemer & Wang, 2021; Makadok, 2001; Größler & Grübner, 2006; Amit & Schoemaker, 1993; Schendel, 1994).

The different types of resources fall broadly into three categories (Makadok, 2001): tangible (e.g., technology and physical resources), intangible (e.g., reputation and culture), and human (e.g., employees' skills and know-how). Consistent with this, the SW enabling resources can be categorized as tangible (ICT-based solutions), intangible (organizational culture), and human (employees' mindset and digital skills) resources. Whereas digital leadership is the organizational capability that gives firms the capacity to develop, deploy, assemble, and integrate the SW enabling resources for a desired result, namely the effective implementation of SW with the achievement of better organization performance.

3 Research model and hypotheses

3.1. Effects of SW enabling resources on the organization performance

The availability of ICT-based solutions allows smart workers to effectively collaborate, coordinate with each other, and perform their tasks independently by time and place. Advanced technology-based platforms contribute to improve interconnectivity, favoring interactions and enriching the communication among employees within smart working organizations (Larkin 2017; Shah et al., 2017). Studies have also shown the positive effects of digitalization, referring to the

usage of any digital assets, on the organizations' performance (Kuusisto, 2017; Ribeiro-Navarrete et al., 2021). Its benefits are numerous and include automating and optimizing processes to improve productivity, saving costs, streamlining production, and supporting the decision-making process (Parida et al., 2019; Scott et al., 2019). Furthermore, the use of digital technologies enables firms to quickly interact and share in-depth information and knowledge (via digital channels), enhancing knowledge exchange and organizational learning, and boosting innovation (Kamalaldin et al., 2020).

Thus, the following hypothesis is proposed:

> *H1. Advanced ICT infrastructure and digital technologies (Technology) positively influence organization performance in SW settings.*

A number of studies grounded on the theory of reasoned action analyzed the importance of mindset or attitudes in guiding individuals towards desired behaviours (Ajzen & Fishbein, 1980; Ajzen, 1991). Attitude or mindset determine the intentions towards a certain behaviour, defining how much effort the individual will exert in order to perform the behaviour. The perceptions of the behaviour's consequences and the value ascribed to those consequences shape the individual mindset and attitude.

Based on the notions and concepts developed by the theory of Reasoned Action, many researchers pointed out that employees' mindsets and attitudes toward the use of new information and communication technologies positively influence employees' intention to use and exploit ICT in the workplace (Agarwal & Karahanna, 2000; Venkatesh & Davis, 1996). Therefore, the positive attitude toward ICT and an ICT mindset of employees will increase the acceptance to adopt a new ICT-based working practice like SW.

Some empirical studies have also revealed that SW is positively viewed especially by those employees who had technological and digital skills (Carbonara & Pellegrino, 2021; Risi & Pronzato, 2021).

Based on the above discussion, the following hypothesis is proposed:

> *H2. Employees' mindset and digital skills (People) have a positive impact on the organization performance in SW settings.*

The adoption of SW has implications at the level of organizational structure, individual workforce and managerial practices (Bentley et al., 2016; Johnson et al., 2020), bringing a number of benefits and advantages, but has also revealed some problems. These problems include worker monitoring and control measures, the absence of face-to-face interactions and direct feedback, and depersonalized

approaches to managing work (Alward & Phelps, 2019; Suh & Lee, 2017). At the level of group and organization, scholars have suggested that SW hampers visibility and social interaction, which can affect trust in working teams (Allen et al., 2015; Hafermalz & Riemer, 2021), create a sense of exclusion and perceptions of surveillance (Soga et al., 2020), threats the cohesion in organizations (Bentley et al., 2016). Further, there are negative effects on team working (Jacobs & Padavic, 2015; Zarei et al., 2021; van der Lippe & Lippenyi, 2020). These are manifested in an increased job insecurity (Kolasa et al., 2021), withdrawal behaviors (Stirpe & Z´arraga-Oberty, 2017), and a lack of engagement of employees (Golden et al., 2012), with negative effects on performance. These problems call for changes in the organizational culture and the adoption of new managerial and HRM practices.

Studies on virtual teams suggested that higher levels of individual and team performance are measured for companies with a strong cooperation and collaboration culture, based on trustworthy relationships among employees and between employees and management. Creating sharing goals, establishing and maintaining trust through timely and open responses, as well as by giving feedback (Henttonen & Blomqvist, 2005), monitoring team progress, and enhancing team visibility inside and outside the organization (Malhotra et al., 2007) are solutions to positively influence performance in SW organization.

Furthermore, a common assumption in the studies on SW is that managers should place more emphasis on output controls when dealing with the challenge of not being able to directly monitor the behaviour of employees who adopt smart working (Groen et al., 2018). In other words, the reduced possibility of monitoring employee behavior, characterizing SW settings, should be compensated by an increased emphasis on output controls (Poelmans & Beham, 2008; Martin et al., 2013).

This assumption is in line with control theory, which suggests that when direct monitoring of employees is not possible, output controls will become more important (Eisenhardt, 1985; Ouchi, 1979; Snell, 1992), which means managers will place more emphasis on targets, performance indicators, and outcomes in managing their employees.

We thus propose the following hypothesis:

> *H3. A trust-based organizational culture and performance-based managerial practices (Culture) have a positive impact on the organization performance in SW settings.*

3.2. The mediating role of digital leadership

We also believe that the hypothesized associations between SW enabling resources and the organization performance might be contingent on certain organisational conditions.

In light of RBV theory, firms to take full advantage of the resources they control must develop a set of capabilities (Barney, 1991; 2001; Prahalad & Hamel, 1990; Ray et al., 2004). That is, capabilities enable firms to use their resources to increase their performance and gain competitive advantage.

In this study, we argue that digital leadership is an important capability that may affect the effective exploitation of SW enabling resources for increasing organization performance.

In particular, digital leadership is recognized as a key capability that enables an organization to effectively adopt new digital technologies (Nwankpa & Roumani 2016; Ravesteijn & Ongena, 2019). A great part of the recent studies argues that solely possessing a technology is not sufficient for increasing organizational performance and it has been observed that organizations lacking digital leadership capability have failed to exploit the full potential of technologies (Boomer, 2019). Digital leadership prepares companies to adopt and exploit new digital technologies, defining and executing the correct steps to digital transformation (Saldanha, 2019).

Furthermore, the degree of users' acceptance of novel technology influences their performance. Lower is the acceptance and lower is their propensity to use the new technology and, as a consequence, their task performance. According to the Technology Acceptance model, the two primary factors affecting users' attitudes and intention to use new technologies are perceived usefulness and perceived ease of use (Davis, 1989; Agarwal & Karahanna, 2000; Venkatesh & Davis, 1996). Further extensions of the Technology Acceptance model have been proposed to understand which other external factors intertwine with perceived ease of use, usefulness, and attitude toward technology in influencing technology use intention (Reynolds et al., 2020; Venkatesh & Davis, 2000; Venkatesh et al., 2003). Among these other factors, not only the employees' digital skills and competence (Antonietti et al., 2022; Backfisch et al., 2021), but also the leaders' technology readiness and attitude toward technology (Normala et al., 2013; Reynolds et al., 2020) have been proved positively influencing the users' technology acceptance.

Finally, changes in the organizational culture and managerial practices are also required to fully exploit the advantages of new digital technologies and are often considered as enabling framing conditions for digital innovations (Wiesböck & Hess, 2020).

Digital technologies, in fact, can be used to their full extent only in trust-based organizations where information is disclosed among different groups of people and collaboration is promoted (Albu & Flyverbom, 2019). Furthermore, as the availability of data and information increases, employees are well-informed about all processes and demand for self-organization, more empowerment and participation (Carasco-Saul et al. 2015). In this context, managers will not need to apply monitoring mechanisms but have to design new forms of control and employee engagement (Gierlich-Joas et al., 2020). Digital leadership has been conceptualized as a new leadership style that can foster and support these organizational changes, as it empowers employees to better master their daily tasks (Heuman et al., 2015), has a significant effect on work engagement, assures participation, trust and collaboration, thus promoting a more participative culture (Guzmán et al., 2020).

Hence, we propose:

> *H4: Digital leadership mediates the relationship between the organization's performance and (a) technology availability, (b) employees' digital skills and capabilities, and (c) a trust-based organizational culture and performance-based managerial practices.*

The hypothesized conceptual model is presented in Figure 1.

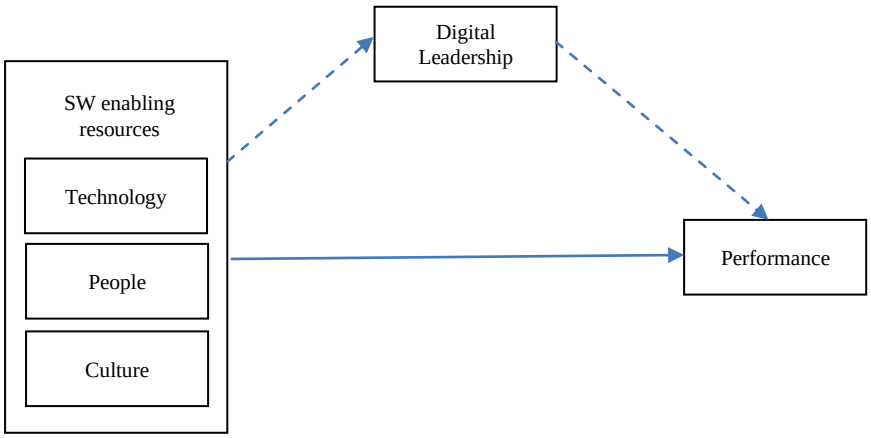

Figure 1. The conceptual model – Dotted line denotes the indirect relationship, digital leadership construct as a mediator.

4 Research method

4.1. Data collection

To empirically investigate the proposed hypotheses, a survey was conducted on a sample of employees working in Southern Italy public utility companies. 234 people participated in the online survey, and the questionnaires of 209 participants were available for analysis, achieving an 89.3% response rate. Table 1 shows the characteristics of the respondents.

Table 1. Characteristics of the respondents.

Demographic characteristics	Number of respondents	Percentage of respondents
Gender		
Female	87	41.63%
Male	121	57.89%
Not specified	1	0.48%
Years		
26-35	21	10.05%
36-45	54	25.84%
46-55	74	35.41%
>56	60	28.71%
Educational Qualification		
Middle school diploma	4	1.91%
High school diploma	84	40.19%
Bachelor/master's degree	86	41.15%
Postgraduate degree (PhD or Master)	34	16.27%

This study uses a survey-based method to evaluate the assumptions of the research model (Figure 1). In order to structure the questionnaire, several steps and a pre-test were carried out. First, the items for each construct of the research model were defined on the basis of an in-depth review of the existing literature, and all the items were measured by a 5-point Likert scale, with "1" representing "strongly disagree" and "5" representing "strongly agree". The first version of the questionnaire was evaluated and modified by the authors in several discussion sessions to validate the items. In addition, the survey was reviewed by experts to ensure that all questions were clear and accurately represented the topic under investigation. Following the implementation of the suggested improvements, the survey was sent to the participants and they were assured that their personal information would remain confidential. The surveys were returned via email. A

summary of the questionnaire' items for each construct is provided in Appendix A.

4.2. Data analysis

This study conducted structural model analysis (Ringle et al., 2017) by employing the partial least squares (PLS) method, which has become a standard tool used to validate hypotheses rather than assessing the overall fit of models (Chin & Gopal, 1995). PLS is also appropriate for analysing the model with a single construct, or formative structure construct. In addition, PLS-SEM offers more flexibility by avoiding inadmissible solutions and factor indeterminacy issues (Fornell & Bookstein, 1982). Moreover, PLS-SEM approach is useful for theory development when models are in an explorative stage (Nitzl, 2016). This methodology was also chosen because it is well suited to small sample sizes (Hair et al., 2013) and allows the estimation of complex models with a large number of constructs, indicator variables and structural paths without imposing distributional assumptions on the data (Hair et al., 2019). In this study, we performed preliminary tests on the data sample in order to exclude bias and then the model was analysed following a two-step approach: 1) assessment of the reliability and validity of the measurement model, 2) examination of the structural model (Chin, 2010).

5 Results

We received 209 completed answers by the selected population. According to Cohen (1988) and Hair et al. (2013), the recommended sample size for applying the PLS-SEM analysis to our model, with a minimum R2 value of 0.10 and a statistical power of 80%, is 137. Therefore, the size of our sample (i.e., 209) is well above the recommendation.

5.1. Preliminary Tests

We conducted tests to ensure the validity of the data collected. Firstly, the non-response bias was assessed by comparing the difference between the responses from the early and late respondents (Armstrong & Overton, 1977). We found no significant statistical difference ($p > 0.05$) after applying the t-test to the responses of the two sub-samples based on the date of receipt of the

questionnaire (N = 105 and N = 104, respectively), confirming that non-response bias was not a problem in our study. Secondly, we investigated the issue of common method bias since it is common for all research projects that employ a survey-based tool to acquire the data. This bias refers to the fact that the variance is a result of the measurement process rather than the model structure (Podsakoff et al., 2003; Podsakoff & Organ, 1986). We used Harman's single factor to test the presence of CMB. In Harman's single-factor test, the key components were subjected to an exploratory factor analysis in which all indicators were clustered into a single dimension. The Harman test revealed that no one factor explained all of the item variations and that the first factor did not account for the majority of the variance. Thus, common method bias did not appear to be a concern according to the accepted parameters for Harman's single-factor test.

5.2. Measurement Model

After validating the responses collected through the questionnaire, we assess the validity of the model both in its individual items and then in its constructs. Table 2 shows the summary of the parameters considered to demonstrate the validity of the proposed model. Considering the items, we investigated their reliability by analyzing the loadings that must be greater than 0.708, since they indicate that the construct explains more than 50 per cent of the indicator's variance according to Hair et al. (2013).

Table 2. Parameters Model Summary.

Construct	Items	Loadings	Composite Reliability (CR)	Cronbach's alpha	Average Variance Extracted (AVE)
Technology	T1	0.764	0.839	0.745	0.567
	T2	0.753			
	T3	0.691			
	T4	0.800			
People	P1	0.685	0.871	0.824	0.577
	P2	0.753			
	P3	0.854			
	P4	0.812			
	P5	0.677			
Culture	C1	0.649	0.904	0.877	0.576
	C2	0.681			
	C3	0.796			

	C4	0.850			
	C5	0.796			
	C6	0.784			
	C7	0.737			
Digital Leadership	DL1	0.810	0.900	0.866	0.600
	DL2	0.762			
	DL3	0.730			
	DL4	0.829			
	DL5	0.770			
	DL6	0.742			
Performance	PER1	0.739	0.905	0.869	0.656
	PER2	0.785			
	PER3	0.844			
	PER4	0.872			
	PER5	0.804			

Considering the constructs, we first tested the internal consistency by checking both Cronbach's alpha and the composite reliability and since they were all above the lower limit of 0.60 the internal consistency was established (Hair et al., 2017). Secondly, we confirmed the discriminant validity using the heterotrait-monotrait ratio (HTMT) ratio which was found to be always less than 0.9 (Hair et al., 2013), as shown in Table 3.

Table 3. Discriminant Validity.

Construct	T	P	C	DL	PER
Technology (T)	-				
People (P)	0.571	-			
Culture (C)	0.702	0.434	-		
Digital Leadership (DL)	0.845	0.331	0.799	-	
Performance (PER)	0.432	0.741	0.519	0.421	-

5.3. Structural Model

After confirming the goodness of the model constructed in the measurement model analysis, we carried out the analysis to reveal the relationships between the constructs and finally answer the research questions. Firstly, the findings showed that the model can explain an adequate portion of the variance of the constructs, still confirming the goodness of the proposed model (R^2 for Digital Leadership is 0.634, R^2 for Performance is 0.543). Table 4 reports the results of the PLS structural model analysis.

The results show a positive and significant direct relationship between organizational performance and "people" (β = 0.645, p = 0,000) and "culture" (β = 0.189, p = 0,019). Such findings demonstrate that employees' mindset and digital skills as well as a trust-based organizational culture and performance-based managerial practices have a positive impact on organisational performance in SW settings. Therefore, H2 and H3 are supported.

Conversely, we find that the "technology" has a negative and weakly significant direct effect on the performance (β = - 0.116, p = 0,096). This result does not support H1 and can be explained by the specific working conditions in which many workers find themselves, characterized by continuous technological changes, the adoption of new technologies, which are not familiar with, processes not adequately redesigned and digitized, and low technology acceptance.

H4a examined the mediation effect of digital leadership on the relationship between technology and performance. The results revealed that the path from technology to digital leadership (β = 0.436, p = 0.000) was significant and positive, while the path from digital leadership to performance (β = 0.124, p = 0.076) was also significant and positive. The results showed that the indirect effect of technology on performance (β = 0.054, p = 0.080) through digital leadership was significant. Thus, both the direct and indirect effects of technology on performance were significant and positive, which indicated a mediation effect of digital leadership.

H4b examined the mediation effect of digital leadership on the relationship between people and performance. The results revealed that digital leadership did not mediate the relationship between people and performance (β = −0.011, p = 0.114).

Finally, H4c examined the mediation effect of digital leadership on the relationship between culture and performance. The results revealed that the path from culture to digital leadership (β = 0.500, p = 0.000) was significant and positive, while the path from digital leadership to performance (β = 0.124, p = 0.076) was also significant and positive. The results showed that the indirect effect of culture on performance (β = 0.062, p = 0.080) through digital leadership was significant. Thus, both the direct and indirect effects of culture on performance were significant and positive, which indicated a mediation effect of digital leadership.

To sum up, the findings showed that digital leadership can be considered an underlying mechanism that explains the relationship between "Technology" and "Culture" with the organization performance.

Table 4. Structural model summary.

	Path coeff.	Standard deviation	P values
DIRECT EFFECTS			
Technology → Performance	-0.116	0.089	0.096*
People → Performance	0.645	0.058	0.000***
Culture → Performance	0.189	0.091	0.019**
Technology → Digital Leadership	0.436	0.062	0.000***
People → Digital Leadership	-0.088	0.056	0.058*
Culture → Digital Leadership	0.500	0.060	0.000***
Digital Leadership → Performance	0.124	0.086	0.076*
INDIRECT EFFECTS			
Technology → Digital Leadership → Performance	0.054	0.038	0.080*
People → Digital Leadership → Performance	-0.011	0.009	0.114
Culture → Digital Leadership → Performance	0.062	0.044	0.080*

6 Conclusion

The Covid-19 pandemic has brought about profound changes in the socio-economic relations of our societies. In this context, the adoption of digital technologies and new working practices has allowed the economic sector to continue its activities and not to collapse due to the health and distance needs caused by the pandemic. In this context, the practice of SW has allowed companies, public administrations, universities and the economies of countries in general not only to continue their activities but also to overcome previous levels of performance. The effective use of this practice needs the resources to implement it in organizations, i.e., technological resources, employee capabilities and skills, and the culture the mindset for adopting new practices in the organization. Moreover, considering the pivotal role of digital technologies, the academic literature point out that digital leadership is a key capability to support companies in advancing the digital transformation process. Thus, the role of digital leadership could have been central to the effective implementation of SW. However, despite the relevance of the resources (i.e., technologies, skills and

culture) and digital capabilities in achieving optimal performance in organizations, their role in the effective implementation of SW has not been investigated in the academic literature, to the best of the authors' knowledge. Aiming to fill this gap, in this study we developed a research model grounded on RBV theory to investigate the relationship between resources and digital leadership with the organization's performance related to the implementation of SW. We tested the hypotheses proposed in the research model and confirmed the pivotal role of resources and digital leadership on organizations' performance. In particular, our findings demonstrate that all the resources had an impact on the organization performance and showed capabilities (i.e., digital leadership) as an explaining mechanism of the success in achieving optimal organization performance when implementing the SW. Therefore, in this regard, firms are likely to increase their performance when implementing SW by adopting specific resources and developing capabilities as digital leadership. Our Hypotheses validate the resource-capability-performance relationship, consistent with other studies (Lu et al., 2010). In particular, our findings demonstrate the important role of digital leadership that can be considered an underlying mechanism that explains the relationship between "technology" and "culture" with the organization performance.

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Appendix

Construct and Items.

Construct	Item	Code	References
Technology	The organization provided the necessary technological resources to work in "SW".	T1	Petrillo et al., 2021; The Italian Presidency of the Council of Ministers, 2020
	The organization has equipped itself with cloud applications to store data and guarantee privacy.	T2	
	The documents I use to do my work are digitalized.	T3	
	The organization adopts the necessary systems to ensure data security (e.g. VPN and data encryption techniques).	T4	
People	I have the skills to use cloud platforms for storing and exchanging information and data.	P1	Ravarini & Strada, 2018; Kim et al., 2018; Heidt et al., 2022; Ko et al., 2021
	I have the skills to use remote communication software (call/videocall).	P2	
	My digital technology skills allow me to work in agile mode without difficulty.	P3	
	It is easier for me to work autonomously when I work in	P4	

	SW.		
	I feel more motivated when I work in SW.	P5	
Culture	Relations with colleagues and managers are based on mutual trust.	C1	Raguseo et al., 2015; Waizenegger et al., 2020; The Italian Presidency of the Council of Ministers, 2020; Mohammed, 2018
	In the organizational unit where I work, there is close cooperation among colleagues.	C2	
	My supervisor and the heads of other organizational units take actions to promote and verify the organizational climate.	C3	
	My performance targets are properly defined and formalized.	C4	
	The organization has properly structured and managed performance monitoring systems.	C5	
	I take an active part in my manager's decisions regarding my work and performance targets.	C6	
	My work is evaluated on the basis of results achieved.	C7	
Digital Leadership	The top management of the organization and my manager encourage using digital technologies.	DL1	flexibility.co.uk, 2015; The Italian Presidency of the Council of Ministers, 2020; Iannotta et al., 2020
	The top management of the organization and my manager encourage adopting the SW.	DL2	
	The organization's management and/or digital transition manager (if any) has defined a plan of interventions and guidelines for digital transition.	DL3	
	The top management of the organization and my manager encourage to choose and experiment with new ways of working that can improve my results.	DL4	
	In the Agile Work mode, mechanisms (regular meetings, cloud-sharing of documentation, alerts on procedure status, etc.) have been defined to ensure coordination with colleagues, superiors and other organizational units.	DL5	
	The top management of the organization provides training programs to improve and/or upgrade employees' digital skills.	DL6	
Performance	When I work in SW, my work is strongly oriented toward the satisfaction of users/customers external and internal to the organization	PER1	The Italian Presidency of the Council of Ministers, 2020; Raguseo et al., 2015; Angelici & Profeta, 2020
	When I work in SW, the timing of operational and decision-making processes has not lengthened.	PER2	
	When I work in SW, the quality of service delivered to the user/client (internal and external to the organization) did not worsen.	PER3	
	The introduction of SW has positively impacted the efficiency and effectiveness of the organization.	PER4	
	When I work in SW my performance improves.	PER5	

Managing the Metrics of Academic Publishing: Private Benefit at Public Cost

Stuart Macdonald

School of Management
University of Leicester, UK

Abstract

The management of academic performance in higher education has become the management of gaming. All actors in academic publication - individual academics, editors, universities, publishers - game to create the metrics that will bring them most personal reward. Much gaming is - like the white lie - considered mild and is scarcely noticed: an author self-citing more than previously; an editor pleased when authors cite more of the journal's own papers; a university congratulating employees for publishing in top journals; authors making the most of their research by spinning one paper into three or four; social and other media coverage emphasising the impact of a group's research, new research collaborations bringing a proliferation of co-authors, each likely to self-cite their paper, and so on.

But this amateur gaming is being overtaken by more sophisticated gaming. It has become normal for authors to cite themselves dozens of times; for editors to coerce authors into citing their journal's papers on pain of rejection; for universities to pay publication bounties well in excess of salaries; and for authorship to be extended to any name that will contribute to a paper's metrics. Journal papers have become formulaic, designed to fit citation requirements rather than to say anything new, or perhaps anything at all in that many are never intended to be read and some are quite unreadable. Vacuous 'water is wet' papers that can be cited just about anywhere in support of just about anything are highly valued. The editors of the *BMJ* and the *Lancet* are as one in declaring that most papers published in medical journals are disgraceful, and that the main task now facing medicine is erasing the rubbish from the record.

The metrics used to measure academic performance do no such thing, in small part because achieving the measures has become an end in itself, and in large part because the metrics, being key to competition, are universally gamed. When no one knows who has written a paper except that it is unlikely to have been any of the paper's listed authors - the situation encountered in many medical journals - this is extreme gaming, as it is when authorship slots are openly sold and bought, or when publishers sell tailoring services to fit papers to the requirements of their own journals. The public good is no longer served by castigating essay mills and predatory publishers when very similar services are provided by the 'legitimate' academic publishing industry. Nor is it served by relying on peer review to maintain standards; referees are reluctant to serve this system and are being replaced by editorial assistants who simply reject what is unlikely to be cited.

Keywords – academic publishing, metrics, gaming, peer review

Paper type – Academic Research Paper

1 Managing the history of academic publishing

Academic publishing is not what it seems, but then it never has been. There has always been a divide between the public face of academic publishing and the hidden underbelly. In recent decades, the divide has become wider and deeper. Some attention may be required.

The fanciful notion that the scientific enlightenment of 17th century Europe was built on peer review has come to serve the needs of modern academic publishing,

> *From these early efforts gradually emerged the process of independent review of scientific reports by acknowledged experts that persists to this day. (Lee et al., 2013, p.3)*

For centuries, editors of scientific journals published whatever took their fancy. No doubt they would occasionally consult friends on the merits of a paper, but often they were pushed for copy and forced to fill their pages with whatever they could get, which was often whatever pleased the rich and powerful:

> *I am under the Necessity sometimes of inserting Communications that are not altogether to my Mind, merely because that better cannot be got and also from a desire to keep well with people, who though imperfectly qualified to write are yet good friends to the Magazine (editor of Farmer's Magazine to George Culley, 17 March 1803, Northumberland County Record Office, ZCU/25*.

Progress in the agricultural revolution was fundamental to progress in the industrial revolution of the 18th century Britain and agricultural societies throughout the land published transactions filled with recipes for improvement, often much more enthusiastic than informed. The fashion for agricultural improvement consumed the landowning classes – even the king, Farmer George, was hooked - and no peer review on earth prevented the great and the good foisting their nostrums on the world at large:

> *… such men as Lord Brougham, who … makes a boast of his ignorance, and who, in his dotage, pours out such ravings as would not be allowed for*

> *a moment from any poor farmer. (Westminster Gazette, 20 October 1949, quoted in Edwards, 1974, facing p.45)*

In three centuries of peer review, suspiciously little evidence has accumulated of peer review leading to the rejection of papers. It may be that peer review was more valued in the theory than in the practice. Robert Maxwell explored the business prospects of academic publishing in the Oxford of the 1950s. He was quick to spot the business opportunity in a peer review system that would guarantee the quality of the publishing product and would cost him, as academic publisher, almost nothing, whether it worked or not. Many of the other costs of academic publishing were in the same attractive category: academics wrote papers for nothing, and they edited journals on the same terms. Even their research was financed by someone else. What was not to like? Maxwell, the war hero, busied himself cultivating Oxford academics, ever amazed at how easily flattered they were. And so unworldly; they really did believe that Maxwell had no ambition beyond helping them provide their thoughts to the world in return for the world's recognition of their brilliance. Academic publishing must have seemed not unlike the fashion business; much as *Vogue* signaled what everyone should be wearing, so academic journals might signal what everyone should be reading and citing.

> *… in the boom years after the second world war, entrepreneurs built fortunes by taking publishing out of the hands of scientists and expanding the business on a previously unimaginable scale. And no one was more transformative and ingenious than Robert Maxwell, who turned scientific journals into a spectacular money-making machine that bankrolled his rise in British society. (Buranyi, 2017)*

Robert Maxwell did not survive long enough to witness the explosion in academic publishing that accompanied the sudden expansion of higher education from the 1970s, impelled by the fancy that a country could not compete unless at least half its workforce were graduates. Maxwell's business model - buy copyright cheap from academics who really just wanted to be published - proved sound. He founded Pergamon in 1949, which eventually became Elsevier, the largest of all the academic publishers. Declared unfit to run a public company, Maxwell was ruthless and totally unconcerned with any public value scholarship might have (Barker and Sylvester, 1991).

> *... the big publishers have rounded up the journals with the highest academic impact factors, in which publication is essential for researchers trying to secure grants and advance their careers. (Monbiot, 2011)*

Academic publishing received further impetus from the notion that higher education was an industry rather than a charity and so required appropriate management of its resources, particularly its workforce. Maxwell was very interested in the proper management of the academic workforce.

2 Managing the academic workforce

The business plan of higher education required a new approach to the management of academics. Whatever ambitions might have had to contribute to public knowledge was no basis for running the international businesses that universities aspired to be. There were lessons to be learnt from business schools, rapidly coming to incorporate (and often oust) a good few of the university's traditional disciplines. Their logic was straightforward: employees were not to be trusted, especially to play their part in meeting organizational targets rather than their own. The solution was to measure their performance, enabling those who complied to be rewarded, and those who did not to be punished. Measuring all the output of an academic's endeavour was always going to be a challenge too far, avoided by assessing a single representative aspect - journal publication.

The new computing power of the 1950s allowed those who were so inclined to trace and measure academic citation. For Robert Merton, a proponent of sharing information within a collegiate environment, whether visible or invisible, this meant an ability to match library orders to academic demand, and to follow the flow of intellectual ideas. For Merton's student, Eugene Garfield, the new capacity to find who was citing whom might just realize a private benefit distinct from the public benefit envisaged by Merton. Garfield founded his Institute for Scientific Information (ISI) in 1958 and remained chairman of what is now Clarivate ISI - personally responsible for blighting academic life for decades - until his death in 2019.

Garfield's prescience was remarkable, though his business plan required that two conditions be satisfied. The first was that citations were a reliable measure of academic quality: the more citations of a paper, the better the paper. This is a nonsense, of course. A paper might be cited for all manner of reasons, including

demonstrating how awful it is. But opposition could always be overcome with recourse to that backstop of academic publishing, peer review:

> *Even in high IF journals there are some poorly cited papers. But even these poorly cited papers are usually good, professional papers. They went through the sieve of thorough refereeing and editing. (Garfield and Pudovkin, 2015, pp.10-11)*

The second condition was that academics could be persuaded to throw collegiality to the winds and compete fiercely with each other using citation as a measure of their success. Could academics be persuaded? They certainly could, even if it meant accepting citation as a valid measure of quality.

3 Managing the game

The measurement of performance is fundamental to academic life. Performance measures determine career prospects and research funding. More fundamental still is gaming - achieving the measure rather than the performance itself. Gaming, by all players in academic publishing, is now universal and compulsory in that competition will rapidly weed out those who refuse to game. Competition, though, is not in performance or even the measures of performance, but rather in gaming proficiency.

Citation is key to the game and brings together authors, editors, and publishers in common purpose. Authors self-cite shamelessly and bring in co-authors in the sure knowledge that they too will cite themselves and so the paper. The author must submit the sort of papers editors and publishers want. These are papers that contain citation to papers in their own journals, and will also be readily cited themselves. Papers with short titles will attract citation as will papers with a single theme and simple abstract. The less readable a paper, the more it impresses those who are reluctant to read it anyway and the more likely it is to be cited (Wang *et al.*, 2022; Ante, 2022). Papers which eschew the latest research (which is too unconnected to past research to be readily cited) are required, positive, unquestioning papers that can be cited just about anywhere in support of just about anything.

> *Every university is pushing publishing so hard that this results in significantly lower quality research in total … the vast majority of work is derivative, or makes observations that amount to 'this tiny square of the*

> *sky is blue … unlike the sky over there which is blue'. (editor quoted in Karabag and Berggren, 2016)*

The typical academic paper has evolved into an homogenous thing designed to yield the most in terms of metrics with minimum academic effort and minimum content (Kaltenbrunner *et al.*, 2022). The measures of performance quickly come to bear no relationship to actual performance and become a measure of gaming proficiency instead (Fire and Guestrin, 2019). Academic research can be described with no reference at all to content. Measures have replaced content entirely.

> *H-index: 29; total citations: 2962 (2505 without self citations); citing articles: 1953 (1852 without self-citations). Average citations per item: 25.18. The most highly cited paper has received 442 citations. From Google Scholar: H-index: 35 (22 since 2012); i-10 index: 88 (53 since 2012), total citations 4377 (2398 since 2012). (academic's job application cited in Wood, 2021, p.13)*

Much citation is actually wrong in any scholarly sense (Simkin and Roychowdhury, 2003, 2005). About a quarter of citations in top journals turn out to be wrong (Smith and Cumberledge, 2020); and authors are unfamiliar with something like half the works they cite (Teplitskiy *et al.*, 2018). And when there is no citation to hand, one can simply be fabricated (Harzing, 2023).

4 Managing academic publishing

The academic publishing industry could hardly have been more delighted by developments in the measurement of academic quality. As if it were not blessing enough that the market for its product worked for free to make the product, that citation of the product was rapidly becoming a measure of its quality was manna from heaven. In almost literal sense, the industry was printing its own money. Indeed, it was to become one of the largest and most profitable of all industries (Harvie *et al.*, 2013), in the same league as the pharmaceutical and armaments industries – and with a similar reputation. Just how could an industry supposedly bringing knowledge to the world have sunk so low?

An oligopoly of academic publishers – the Big Five – is responsible for over half the world's academic publication. The publishers' customers were once anyone who read academic journals and especially the members of the large libraries that took out subscriptions with academic publishers. The subscription model is no longer dominant, being gradually replaced by a variety of open access systems.

These allow the reader free access to journals (which brings obvious public benefits), the publisher now being paid by the author (which brings less obvious public costs). These arise from acceptance that the author rather than the public is the customer of academic publishing. Academic publishers, never keen on negotiating with powerful subscribers and waiting years for their money, are delighted to be paid up front, especially as this allows them to relate the customer's requirements to their own. Editors and publishers are as interested as authors in papers that will be much cited and so contribute substantially to the impact factors (JIF) of their journals (Ashkanasy, 2007). As a universal measure of journal quality, the JIF is as inadequate as the citation metric on which it is based. For instance, the JIF of the *British Journal of Medicine* is above 30, that of the *Lancet* over 60.[1] This compares with an impact factor of 6 for *Research Policy* and 3 for *Human Relations*, both top journals in the social sciences, and just 0.1 for *Notes and Queries*, a prominent publication in the arts. The higher a journal's impact factor, the more its papers will be cited (regardless ot quality) and the more it will attract submissions to be cited and boost the JIF. The higher the JIF, the more academic publishers can increase their article processing charges (APC), though it is a mystery how the cost of publishing a journal can be affected by alterations in a JIF.

'Legitimate' academic publishers have come to resemble the predatory variant. Predatory publishers are also customer-driven, publishing whatever the author wants quickly and generally without the inconvenience of peer review, for a fee very much lower than the APC of the legitimate industry. Predatory publishers serve a market of academics many of whom cannot publish elsewhere and must still acquire quantitative measures performance to satisfy their employers. Often these are authors from developing countries who require publication measures to graduate or retain their jobs. Legitimate publishers are hugely critical of predatory publishers and campaign against them, but really it is hard to see very much difference between the two – except that legitimate publishers charge authors very much more to be published. To a remarkable degree, legitimate publishing has learnt from the predatory industry and has sometimes become even more buccaneering. Whole rafts of its lesser journals carry the brand of the brand of a publisher's most successful journals (Khelfaoui and Gingras, 2020) and journal

[1] *The Lancet has since doubled its JIF for 2022, entirely as a consequence of media coverage and resulting citation of the vast numbers of papers the journal published on covid-19 the previous year (Retraction Watch, 2022; see also Clark, 2023).*

publication has been linked to conference attendance. Both sell services to authors, their customers, which stop just short of writing papers for them, both publish marketing material disguised as academic journals, and both push their own journals to academics as recommended reading. The academic's every internet action provides suggestions for further 'reading' (Gingras, 2020), all from the publisher's own stable, of course. For some editors, the goal is to publish papers which cite nothing that is not from their own journals, thereby boosting JIF at the cost of isolating their journals from external knowledge.

For the modern academic, the value of a paper is private and lies in its citations. The paper's content - its potential value to the public - is very much a secondary matter, as it is to editor and publisher.

> *… it doesn't matter what the fuck you publish, only where you publish it. (academic quoted in Butler and Spoelstra, 2014, p.542)*
>
> *… never before in the history of humanity have so many social scientists written so much with so little effect or of benefit to anyone. (Alvesson et al., 2017, p.3)*

Academic papers are written to be counted rather than read. It follows that readers have become reluctant to waste time on an exercise which has become unrewarding. Internet articles now indicate how much time is likely to be invested in reading them and the market for summaries is thriving:

> *Based on your entire viewing history, you could have saved 12,564 minutes [about 6 years] by using Summaries. (email to author from Academia.edu, 15 August 2021)*

5 Corruption and contagion

The academic establishment is keen to be seen as cracking down on what it portrays as bad apples, individuals who cheat and tarnish the reputation of academic publishing. There is a large literature on their misconduct, but strangely limited to fabrication, faslification and plagiarism (FFP) and, more oddly still, assuming that universities should be policing this misconduct (see Bulow and Helgesson, 2019). FFP barely scratches the surface of misconduct in academic publishing and universities are complicit in much of it. Also complicit is every other part of academic publishing – authors, editors and publishers are all, to some extent, rotten.

In medicine, the decay is so advanced that the rot can no longer be hidden. As the editor-in-chief of the *Lancet* puts it, '[medical] journals have devolved into

information laundering operations for the pharmaceutical industry' (Horton, 2004). Pharmaceutical companies often look to medical communications companies (MCCs) to organize their publication programmes:

> *I wanted to introduce you to one of [Proctor and Gamble's] external medical writers, Mary Royer. […] are you thinking of drafting the publications first and then let Mary take over or would you like Mary to write from the beginning? I'm very flexible. Mary and I have just finished writing a publication with Steven Boonen (Richard you will be contacted as you're a co-author!) and Mary was involved at the very beginning and wrote from scratch. (email from Ian Barton of Proctor and Gamble to Richard Eastell and Aubrey Blumsohn, academics at Sheffield University, April 2003).*[1]

The MCC will write the paper to order, steer it through to publication, and organize its cross-citation with other papers to establish the orthodoxy that is so important in medical research (Fava, 2004).

> *One thing we could do now on this is to contact Roger McClellan at CRC* [2] *and see if they would be amenable to putting this publication in Crit.Rev.Toxicol.* [3] *(email from William Heydens, regulatory product safety assessment lead at Monsanto, February 2015)*[4]

Prominent academics are selected, with the complicity of their universities, to be authors, though they may never have even read the paper which bears their names.

> *An option would be to add Greim and Kier or Kirkland to have their names on the publication, but we would be keeping the cost down by us doing the writing and they would just edit & sign their names so to speak. Recall that is how we handled Williams Kroes & Munro, 2000.*[5] *(email from William Heydens, regulatory product safety assessment lead at Monsanto, February 2015)*[6]

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[1] *Available at http://www.dcscience.net/2007/11/06/universities-inc-in-the-uk/ (accessed April 2020).*
[2] *CRC Press, part of the Taylor & Francis group (see Zou, 2016; Waldman et al., 2017).*
[3] *Critical Reviews in Toxicology (formerly CRC Critical Reviews in Toxicology), a peer-reviewed journal published by Taylor & Francis.*
[4] *Available at https://www.baumhedlundlaw.com/pdf/monsanto-documents/Email-Correspondence-Wherein-William-Heydens-Suggests-Experts-Could-Edit-and-Sign-Their-Names-to-Scientific-Paper.pdf (accessed April 2020).*
5 Probably Williams, G., Kroes, R. and Munro, I. (2000) Safety evaluation and risk assessment of the herbicide Roundup and its active ingredient, glyphosate, for humans, Regulatory Toxicology and Pharmacology, 31, 2, part 1, pp.117-65.
6 Available at https://www.baumhedlundlaw.com/pdf/monsanto-documents/Email-Correspondence-Wherein-William-Heydens-Suggests-Experts-Could-Edit-and-Sign-Their-Names-to-Scientific-Paper.pdf (accessed April 2020).

Organizers of medical conferences routinely write papers for delegates to present (Healy, 2004).

> *Dear David I am delighted you are able to participate in our satellite symposium [...]. In order to reduce your workload to a minimum we have had our ghost-writers produce a first-draft based on your published work. I attach it here [...]. (email to symposium presenter cited in Healy, 2004, p.227)*

Authorship has acquired a new meaning in medicine; it is determined by entitlement rather than contribution to content. Some papers have hundreds of authors, none of whom knows who actually wrote the paper, a situation that has spawned a minor literature not on changing the system, but on the proper criteria for determining the order of so many 'authors'. Medicine warns of a fate that could await other academic disciplines. Corruption - especially corruption justified -breeds further corruption. Universities pay bounties for publishing in top journals, but senior managers feel entitled to authorship (which no longer implies writing) and thus to the bounty. The bounty system is just about universal in China (Quan *et al.*, 2017): the going rate at Zhejiang University College of Medicine for a paper in *Nature* or *Science* was US$30,000 in 2011 (Shao and Shen, 2011). Authorship of papers already accepted by journals is openly bought and sold.

6 The last redoubt

The marketisation of academic life has made referees hard to find. What incentive is there to volunteer for unpaid, unrecognized work, that is often actively discouraged by employers?

> *People are already working 60 hours or more a week and have no time for reviewing submissions; editors have to press friends into doing them favors or tell authors who have had their submission accepted that they will be expected to do a few reviews in return. (Moret, 1997)*

Editors cope by leaving more and more selection to desk review by editorial assistants who may not understand a paper's contents, but can tell whether an author has cited himself and the journal sufficiently, and whether he comes from a decent university (which will increase citations of the paper). Author affiliation has become crucial to whether a submission is sent for peer review. Universities now pay academics from prestigious overseas universities to join the author list

on papers produced by their own staff. This is how Saudi Arabia can lay claim to the world's second most highly-cited papers (King Abdulaziz University is just slightly behind Harvard). South Africa comes in third (Gingras, 2014). Very few papers submitted to even top journals are still sent to referees. Their editors and publishers may still claim a high rejection rate as a mark of quality, but rejection is by people who have little knowledge of the contents of papers.

> *I would like to thank you for your ongoing support of EMJ [the European Management Journal], and update you on how well the journal is going . . . The rejection rate has raised [sic] from 80% to 86%.*[1]

A high rejection rate is most commonly achieved by desk rejection rather than peer review. Editorial assistants throw out papers that will contribute insufficiently to the journal's impact factor, papers that do not cite other papers in the journal (Pearson and Sharma, 2015), papers with few co-authors, papers with short reference lists (see Corbyn, 2010; Harzing, 2013). Only a tiny minority of submissions - the ones assistants have no reason to reject - ever goes to referees and some 30% - 50% of these are accepted (Lawrence, 2007), which rather gives the lie to claims of top journals having rigorous peer review.

> *We … [used] … to make our acceptance criterion those articles that we felt would make a contribution to the international literature. Now our basis for rejection is often 'I don't think this paper is going to be cited.' (editor of medical journal as quoted in Chew et al., 2007, p.146)*

Peer review is the final redoubt of academic publishing is peer review. Individuals may be more reluctant than ever to referee (not least because of the corruption in which academic publishing is mired), but the institution itself is what is valued. A system hallowed by centuries survives to safeguard academic standards, or so the argument goes. But even referees are besmirched by the corruption. Those few individuals who do answer the call tend to see themselves as working for the journal rather than any academic college, and like editors and their teams, are more interested in the citability of papers than their contents.

No group supports peer review more ardently than academic publishers, not because it improves the quality of academic papers, but because it is fundamental to a process which is accepted as garuanteeing the quality of a paper - not that it necessarily does anything of the sort – and therefore underwrites the value of the publisher's product. As editors now find referees hard to recruit, publishers are

[1] *Email from editor of European Management Journal, November 2010.*

compensating for their failure by finding referees themselves, thereby crossing the boundary between the editorial and the commercial. They do this by making a willingness to referee for a journal as part of the manuscript submission system they supply to the journal, a coercion that is ultimately dependent on keywords.[1] Taylor & Francis advises its editors to humanise its manuscript submission system:

> *… edit the wording in the reminder emails to sound more personal if necessary … highlight the benefits that peer review brings to scholarly publishing. (Meager, 2015).*

The UK Information Commissioner has recently ordered Elsevier to change its ways. The largest of all large academic publishers had been pooling data on willingness to referee for individual journals into one vast database that all its editors might dip into for referees. Elsevier has been ordered to stop storing personal information without the knowledge and permission of individuals, and to cease offering editors the services of these individuals as referees.

Metrics have made gathering and processing data big business in academic publishing - and therefore confidential. Exactly how the JIF is calculated has always been a commercial secret, known only to the privileged (see Oravec, 2017). The very JIF listings are proprietary (see Willmott, 2011, p.440). Also confidential are the meetings large academic publishers hold with Clarivate ISI to establish what room there might be for adjustment of their journals' JIFs (Metze, 2010).

7 Clearing up the mess

How to get out of this mess? A start would be to admit that the metrics used to measure academic performance do no such thing, in small part because achieving the measures has become an end in itself rather than the means of achieving the performance, and in large part because, as the end, the metrics are universally gamed Biagioli and Lippman, 2020). Amateur gaming is inexorably being replaced by the sophisticated gaming that has reached such extreme levels in medicine. When no one knows who has written a paper except that it is unlikely to have been any of the paper's listed authors, this is extreme gaming. It is extreme gaming when authorship slots are openly sold and bought, and when publishers take on some of the MCC functions and sell tailoring services to fit papers to the

[1] *The author has been asked to referee his own submission on several occasions. The author's paper on high technology policy entitled 'Milking the myth: innovation funding in theory and practice', and published in R&D Management, resulted in a request from another journal altogether to referee a paper on the dairy industry.*

requirements of their own journals. It is illogical - and a distraction - to castigate essay mills and predatory publishers when very similar services are provided by the 'legitimate' academic publishers.

It does not help that the notion that the author publishes for personal gain has become ingrained in law. In the subscription model of academic publishing the author cedes copyright to the publisher. When the author pays the publisher, the author retains copyright so that the information in his paper (or rather the manner of its presentation) remains his. This has implications. Take plagiarism, the copying of another's work and a heinous offence in universities not because of the theft itself - universities actively plagiarise and encourage staff to follow suit if it improves their performance measures - but because the theft makes a mockery of marking. To discourage students, universities engage Turnitin, now a very large company that can report on the originality of any student script. Turnitin ensures that this process grants it ownership of every student script it inspects, which can then be used to check against yet other scripts. Thus does the university conspire in the theft of the intellectual property of its students. Mario Biagioli (2022, p.477) isolates this aspect of the problem nicely: there is a clash between 'the property-based copyright regime of authorship and the responsibility-based system of scientific authorship'

> *… if the essential features of predatory publishing are unethical behavior and a focus on profit, then many publishers using the subscription model are even bigger predators than some new OA publishers. (Krawczyk and Kulczycki, 2021, p.8)*

Peer review, its performance for too long excused by the democracy defence - that everything else is worse - is in tatters.

> *We portray peer review to the public as a quasi-sacred process that helps to make science our most objective truth teller. But we know that the system of peer review is biased, unjust, unaccountable, incomplete, easily fixed, often insulting, usually ignorant, occasionally foolish, and frequently wrong. (Horton, 2000, p.248)*

Peer review does little more than help sift the most citable wheat from the less citable chaff. In medicine, even referees' reports can be ghost-written (McHenry, 2018). In the uncompromising opinion of medicine's senior editors, the peer review of practice has done nothing in decades to prevent the publication of worthless papers (Altman, 1994; Smith, 2014). Yet, even in its decrepitude, peer

review is paraded by the establishment of academic publishing as the safeguard of scholarship.

Those who claim authorship of what they did not write are, by definition, plagiarists (Sanders, 2020), guilty of defrauding the public (Stern and Lemmens, 2011). They are also guilty of undermining scholarship (Marušić *et al.*, 2011).The morass of high-scoring rubbish resulting from gaming in medicine is probably being replicated in other disciplines. Purging is required, purging much more ruthless than a few retracted papers, purging of the excrescence of the age of publish or perish and its performance metrics, purging that tears aside the cloak of scholarship which hides the diversion of public property to private purpose.

Merton's depiction of the scholar standing on the shoulders of giants is now unfamiliar in higher education. Anyone who can manipulate the metrics can be a scholar (Biagioli, 2019); there is no need for giants. Only the obtuse cannot be aware of what can be achieved by manipulating the metrics (Oravec, 2017). Spoofs galore have been testing the integrity of academic publishing for decades and have often found it wanting. Scott Armstrong (1982), for instance, submitted papers that had already been published to a range of journals. A change of name was enough to fool most editors and referees, but not enough to change the system. The world's sixth most-cited academic does not exist and has never existed (Labbé, 2020; see also López-Cózar *et al.*, 2014; Harzing, 2016). Notwithstanding, Ike Antkare continues to publish (e.g., Antkare, 2020).

Top journals are top journals largely because they are most active in manipulating the metrics and have most to lose from failing to maintain their manipulation. A top journal is just that because citation makes it so (Nieminen *et al.*, 2006; Brembs, 2018; Dougherty and Horne, 2022); in a competitive environment, this can happen only through manipulating the metrics. Editors of top management journals are renowned for coercing citation from authors (Wilhite and Fong, 2012) and for turning a blind eye to plagiarism (Honig and Bedi, 2012). Gaming has become so entrenched and institutions have become such beneficiaries of the system that they feel there is no going back (Biagioli *et al.*, 2019).

Academic publishers have extorted a fortune from a public too trusting to question whether the industry really is working in the public interest. The public still thinks of the world of academic publishing as benign; it is in awe of such academic institutions as peer review. During the covid-19 pandemic, the media (which knows its public well) was able to use peer review as a shorthand: what

had been peer-reviewed could be trusted, what had not been peer reviewed could not be trusted (Schultz, 2023). Of such gullibility are fortunes made.

> *The journal editor says: what's wrong with publishing an industry-funded editorial or review article as long as it gets appropriate peer review? (Elliott, 2004, p.21)*

Clarivate's algorithms could easily be adjusted to exclude self-citation from contributing to the JIF, but they are not. Self-citation might also be discounted in calculations of research productivity and appropriate rewards, but it is not (Baccini et al., 2019).

> *You have to understand that there are some people in [academic publishing] for whom, when Impact Factors are published, it's their life … it's what they've been waiting for all year. It's bigger than Christmas. And people will do their utmost to get the highest Impact Factor possible. (David Tempest of Elsevier quoted in Burboles, 2015, p.722)*

Academic research, misled by previous research, rapidly infects future research (Ross-White et al., 2019). The science base, already distorted by citation determined by the opportunities presented by publication metrics, is further corrupted when authorship is determined by precedence, status and commercial requirements. A science base consisting of whatever citation generates the most favourable publication metrics is not sturdy enough to support much of substance (Higginson and Munafò, 2016).

Self-regulation has failed to protect the public from the ravages of academic publishing. The time has come to consider whether an independent regulator might succeed where academic self-regulation has patently failed. In other industries, regulation is often required to limit anti-social behaviour and reduce costs to the public. Certainly the costs to the public of academic publishing are high in terms of both industry profits and a polluted science base. And surely, despite every effort to pass off the product of academic publishing as scholarship authorised by peer review, there is evidence enough of anti-social behaviour to justify drastic action.

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Human-Centered Knowledge Management in Start-Up and Innovation Managers: Framework, Peculiarities and Challenges

Georgy Laptev*

Faculty of Economics
Lomonosov Moscow State University
Leninskie Gory, 1 bld.46, Moscow, 119991 Russia

Dmitry Shaytan

Faculty of Economics
Lomonosov Moscow State University
Leninskie Gory, 1 bld.46, Moscow, 119991 Russia

* *Corresponding author*

Abstract

The purpose of the paper is to study human-centered knowledge management in start-ups, reveal challenges, its peculiarities, and framework. The technology start-up teams used experiential design thinking, agile and lean approaches to design and validate the hypotheses of minimal viable products and repeatable and scalable business models. The exploratory qualitative research was conducted with 27 cross-functional start-up teams in a period 2019-2023. The research reveals: (1) the necessary knowledge set for start-ups which facilitates entrepreneurial teams to launch new ventures, design products and business models by using human-centered knowledge management framework that includes social-based and technology-based parts for acquisition, creation, sharing/transferring, and application of tacit and explicit knowledge in start-ups; (2) specific set of peculiarities and challenges of KM in start-ups; (3) dominance of the mode "Socialization" in the discovered 3-mode SEI (socialization, externalization, and internalization) knowledge conversion model for early (fuzzy front end) stage of product/business development in start-ups; (4) evidence that conversion “explicit to tacit” knowledge in “Internalization” occurs effectively in combination of explicit knowledge obtained in exploratory prototyping inside of start-up and the knowledge generated by generative AI at the requests of a startup. Practical implication of the research is understanding of framework and challenges of KM in start-ups, and opportunity to use the research results in start-ups management at the fuzzy front-end stage.

Keywords – Human-centered, Knowledge management, Start-up, Experiential design thinking, Innovation.

Paper type – Academic Research Paper

1 Introduction

In digital era, knowledge has become a key resource and valuable intangible asset to gain and sustain competitive advantage through innovation for either large or small companies (Ferreira et al., 2020; Marchegiani, 2021; Durst, et al., 2022; Durst, et al., 2023). Therefore, companies need to acquire, create, and use knowledge effectively and efficiently to create value for their user/customers and to be competitive (Wong & Aspinwall, 2004, 2005). Knowledge management (KM) has become current topic and critical objective in today's large companies, small and medium enterprises (SMEs), and start-ups (Davies and Warren, 2011; Hagmann and Gillman, 2016; Chandler, 2021; Cerchione et al., 2016; Durst et al., 2022, 2023; Centobelli et al., 2017; Cerchione et al., 2016; Audretsch et al., 2020; Audretsch et al., 2021; Ahmed et al., 2021). KM theory and models have developed to facilitate knowledge workers to organize and lead knowledge in organizations since the 1990s (Nonaka and Takeuchi, 1995; Nonaka and Toyama, 2003; Laptev and Shaytan, 2022; Wiig, 1993; Szulanski, 1996; Sveiby, 2001; Dalkir, 2005; Evans et al., 2014; Spyropoulos, 2020; Sima et al., 2022). In Industry 4.0 context, development of ICTs, IoT, RS, AI, etc. provides new technological tools to support KM practices (Becerra-Fernandez, 2008; Bigliardi et al., 2010; García-Álvarez, 2015; Santoro et al., 2018; Colnar et al., 2022; Korzynski et al., 2023).

For a long time, the mainstream of KM research was large organization, less small and medium entities (Massaro et al., 2016; Cerchione, 2016; Durst et al., 2023), and start-ups were neglected almost. There are significant differences between larger companies and SMEs. Small organizations are not little big ones, thereby one cannot transfer KM tools and practices from large organizations to SMEs (Welsh et al., 1982; McAdam and Reid, 2001; Durst and Bruns, 2018). Traditional KM tools/models/frameworks (Gamble and Blackwell, 2001; Dalkir, 2017; Sartori and Frederico, 2020; Hilger and Wahl, 2022) are not simply adaptable to the SME context (Hutchinson and Quintas, 2008; Zieba et al. 2016; Sima et al. 2022). SMEs have limited resources in which they require to be

competitive in volatile, uncertain, complex and ambiguous (VUCA) world (North and Babakhanlou, 2016; Sartori and Frederico, 2020).

Start-ups are companies at the very early stage of development, where like in a lab entrepreneurs set up experiments and test hypotheses, identify, pursue and capture the value from business opportunities (De Massis, 2018), design products and look for repeatable and scalable business models (Blank, 2013). Creating successful innovations is a challenge for startups. A specific startup culture is characterized by openness, collaboration with various categories of stakeholders, and human-centricity. Agile, lean, design thinking practices/methods/tools, and competencies of entrepreneurial management are the key ingredients of start-ups. Nevertheless, scholars still tend to apply approaches developed originally for larger companies on SMEs and there is only very limited number of preliminary ideas of knowledge management roadmaps and frameworks for SMEs (Lisanti and Luhukay, 2014; Centobelli et al., 2017; Sima et al., 2022).

The aim of this study is to propose a human-centered knowledge management frame for the early-stage innovative SMEs (start-ups) when they develop and test product concepts (MVPs), and repeatable business models. The goals of the study are (1) to identify key peculiarities and challenges of KM implementation at start-ups; (2) to propose a human-centered knowledge management framework based on experiential design thinking approach for start-ups.

The paper is structured as follows. In the coming section, authors briefly discuss the background associated with definition and specifics of start-up, knowledge management, experiential design thinking approach. Next, we introduce research design and process. The main finding of the field analysis are illustrated in the fourth section. In conclusion, the results and the direction of further research are formulated.

2 The background of the research: start-up definition and specifics, knowledge management, knowledge management, experiential design thinking

2.1 Start-up is a learning organisation

The lifespan of SMEs can be divided on three stages, i.e. "existence", "survival" and "success" (Lewis and Churchill,1983). The first one, where a new venture is infant and incubated named start-up. Start-up is defined as newly established

organization with the aim target for customer discovery/validation and for disruption of the current state of the industry with innovation (new products or services) (Blank, 2013). Blank (2013) definition of start-up is "*A startup is a temporary organization designed to search for a repeatable and scalable business model*". Start-ups tend to be no bureaucratic, less formal and flexible organization (Durst, 2023). In order to understand the challenges facing entrepreneurs and innovative managers of start-ups with knowledge management, it is necessary to understand specific of startups and their features.

A start-up launches with ambitious and relatively imprecise hypotheses about where an opportunity may lie, and then entrepreneurial team tries to validate the hypotheses through numerous iterations by designing minimal viable products (MVPs) and looking for repeatable and scalable business models (BMs) (Blank, 2013; Ries, 2011). Typically, the entrepreneurs radically change their MVP and BM hypotheses through multiple stages of knowledge gathering and learning by pivoting up to the MVP and BM are revised to arrive at the validated final version (Girotra and Netessine, 2014; Ries, 2011; Blank, 2013; York and Danes, 2014). The action-learning process through iterated "hypothesis – build – measure – learn – new hypothesis" feedback loop. A regular assessment of actions ensures the creation and sharing of knowledge (intangible asset) in start-ups (De Massis et al., 2018). The "lean start-up" approach based on agile experimentation and customer feedback (Ries, 2011; Blank, 2013) allows to enrich a startup with knowledge created and shared within a venture and acquired from external stakeholders.

Resource (capital, time, people) scarcity is the biggest challenge faced by start-ups (Wong and Aspinwall, 2005; Ahmed et al., 2021). That is why start-ups need to use their limited resources to the maximum extent. The knowledge, especially tacit, is one of the main resource, i.e. important intangible assed, for start-ups. Efficient knowledge management (KM) can improve learning process and opportunity of a start-up to design successful product and scalable BM.

2.2 Knowledge management in start-ups

KM includes the different forms (explicit, implicit, tacit) of knowledge, generation of knowledge, knowledge transferring/sharing (Ahmed et al., 2021; Oe and Mitsuhashi 2013), and it conversions (Nonaka and Takeuchi, 1995; Laptev and Shaytan, 2022), knowledge acquisition. KM associates with practices related to the

capture, store, and transfer of explicit knowledge and also with practices linked to develop techniques to share tacit knowledge (Alvarez et al., 2016).

Challenges that start-ups face with the KM are the following: 1) temporary nature of the entrepreneurial team members may break streamlined knowledge transfer/sharing process (Kasvi et al., 2003); 2) focus on short-term tasks which restrict using knowledge management as a business strategy (Lindner & Wald, 2010); 3) many start-ups run out of funds before validating MVP and BM (Cantamessa et al., 2018); 4) decision-making is in the hand of one or small number of people (Culkin and Smith, 2000); 5) lack of organization memory, i.e. most knowledge is kept in the minds of entrepreneurial team members (Alvarez et al., 2016). Some economic, geographical, human, and organizational factors affecting KM, and social network KM tools and practices were studied for start-ups (Presutti et al., 2011; Dalmarco, 2017; Liu et al., 2012; Laitinen and Senoo; 2019).

The literature identifies only few specific KM practices and factors affecting KM, but does not offer comprehensive KM framework used by start-ups in Blank (2013) definition. The authors propose to fill in this gap by human-centered knowledge management practice and tools.

2.3 Experiential design thinking for knowledge management

Design thinking (DT) is user-centred, iterative process driven by multidisciplinary team for innovation design through idea generation where emphasizes observation, collaboration, iteration between stages, exploratory prototyping, user testing and learning (Kelley, 2001; Brown, 2008). Nowadays, DT evolved to participatory-centred approach to complex problem solving with focus on innovations in collaboration with different types of stakeholders (users, customers, suppliers, etc.) (Lockwood, 2009).

Over the past decade, users/customers are increasingly looking for individualised offers and a new experience (D'Entremont, 2020). User/customer experience (U/CX) has become a huge determinant of product and business success. Traditional DT process do not focus on U/CX entirely. Experiential design thinking (EDT) approach puts experiences at the centre by the user/customer experience-centric approach and collaboration with them (Batat, 2021). The process of collaborative innovation development is a complex combination of factors based on innovative thinking (Laptev and Shaytan, 2022) and

entrepreneurial behaviour, i.e. "creating opportunity without regard to the resources currently controlled" (Timmons and Spinelli, 2004).

In volatile, uncertain, complex and ambiguous (VUCA) world many tradition KM practices/tools fail due to misunderstanding of human need, their desire and motivation. EDT as human centred, participatory and driven by experimentation approach can greatly improve KM practice in start-ups where the culture of discovery is a greater extent. The crucial contributions of EDT to KM include the focus on empathy, participatory design, experimentation through rapid prototyping and testing of hypotheses. Mistakes in EDT are referred as leverage toward a right solution and failures are a source of learning. EDT places a greater emphasis through interaction and provides deeper info about users/customers and bring holistic insight of BM. Using MVP approach, EDT combines top-down and bottom-up approaches to problem solving that helps to avoid big fail and design lean innovation. EDT accepts agile approach at the early stages of product and BM design. EDT accepts agile approach, brings better interaction between stakeholders, improves interpersonal conversation and that lead to better knowledge extraction, co-creation and sharing. EDT includes using digital tools, i.e. 3D printing for exploratory prototyping, social media, professional communities and generative AI (like ChatGTP) for knowledge acquisition and sharing.

Considering that start-ups operate in VUCA environment, and that discovery is the main part of their activities, it can be assumed that KM organized on the principles of EDT will be appropriate and effective. Next sections authors looking for confirmation of this assumption.

3 Research design and process

The exploratory qualitative research was conducted during and after 7 university incubation/acceleration programs in 2019-2023. Qualitative methods for research on SMEs were recognised previously (Romano, 1989; Chetty, 1996). The research framework included literature review (97 WoS/Scopus papers), sampling, collection of data and data analysis, through sequential categorizations levels. The sample frame is 27 cross-functional start-up teams, about 4-6 persons each, with mix backgrounds that acquired, created, transferred/shared knowledge, generated and tested hypotheses in collaboration with users/customers. The studied start-ups are technological, design digital or

physical or phygital products. The start-up teams used EDT, agile and lean approaches and iterate "hypothesis – build – measure – learn – new hypothesis" in feedback loop at early (fuzzy front end) stage to create valuable MVP and repeatable/profitable BM (Blank, 2013; Koen et al. 2014; Pereira et al. 2917). The modified EDT model consists of 5 building blocks: 1) Empathic understanding of users/consumers and their problems/needs/desires; 2)Design task (point of view) definition to develop innovative solution; 3) Ideation U/CX and product in user-centric collaboration; 4) Prototyping and testing U/CX and product solution; 5)Business model generation and testing (Shcholokova and Laptev, 2022).

The data collection took place both during and after incubation/acceleration programs on the principle of triangulation applying multiple sources of evidence with the aim to strengthen validity. The research survey is based on observations of the start-up team's work, reflective journals, and in-depth interviews with them and instructors of the EDT activities. After the end of incubation/acceleration programs, which lasted 10 weeks, the members of start-up teams gave feedback by answering closed and open-ended questions prepared by the researchers. The authors visited each research site at least five times to get an idea of knowledge management in practice of start-ups, compare these observations with the interview notes. In cases of contradiction between information from star-up owners and team members, and observations on work conducted, receive further clarification from the owners and managers. Researchers carried out first and a second cycle coding (Saldaña, 2016). Throughout the iterative coding process, the researchers revised and refined categories and themes, i.e. develop categories from the recoded material and structure the categories to get broader themes.

4 Findings

4.1 Knowledge set for start-up

The result of the analysis, 12 categories combined into 3 themes, represent a cumulative set of knowledge in different domains that a start-up team should have for product designing and business modelling (Fig.1). The first theme "Knowledge about Product" includes the following building blocks: *Empathic understanding of user/customer needs, wants & desires; Knowledge about technologies, components & "secret sauce" for product design; Knowledge about product features/specification* and the second theme "Knowledge about Market"

with following building blocks: *Empathic understanding of user/customer & purchasing behaviour; Knowledge about lead sources & lead generation tools/activities; Knowledge about sales funnels & customer actions*. The blocks *Knowledge about user/customer journey/experience; Unique/"unfair" competitive advantage; Knowledge about market (type, size & strategy), and Unique value proposition* are shared between these two themes. The third theme "Knowledge about Financing" includes two building blocks: *Knowledge about venture finance (investment, valuation, source of capital); Financial plan (costs forecast, cash flow statement, P&L, etc.)*

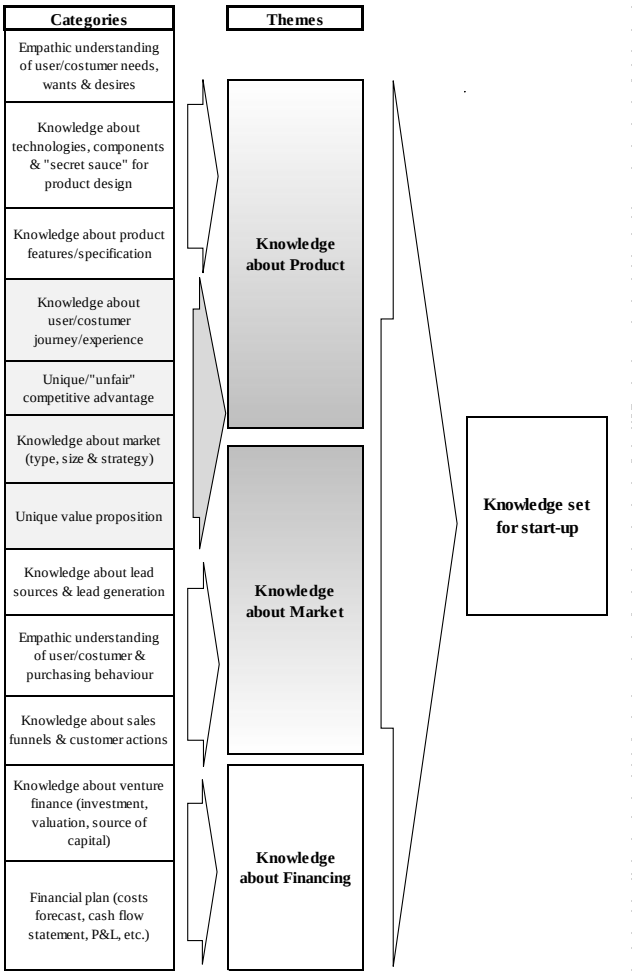

Figure 1. Knowledge set for start-up.
Source: author's elaboration.

The research revealed the necessary knowledge set for start-ups that facilitated entrepreneurial teams to launch new ventures, design products and business models by using human-centered knowledge management framework that included social-based and technology-based parts (Figure 2) for acquisition, creation, sharing/transferring, and application of tacit and explicit knowledge in start-up.

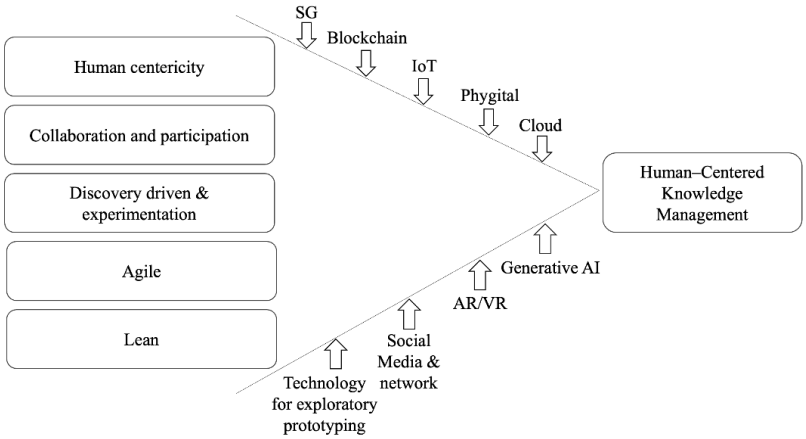

Figure 2. Human-centered knowledge management framework for start-up. Source: author's elaboration.

4.2 Knowledge management peculiarities in start-ups

The study identified specific set of peculiarities of KM in start-ups.

4.2.1 3-mode SEI knowledge conversion model, key roles of "Socialization", exploratory prototyping in "Externalization", generative AI in "Internalization"

The dominance of the mode "Socialization" in the previously discovered SEI (socialization, externalization, and internalization) 3-mode knowledge conversion model for early (fuzzy front end) stage of product/business development (Laptev and Shaytan, 2022; Nonaka and Tackeuchi, 1995; Nonaka et al., 2005). Socialization helps to move and share tacit knowledge between start-up team members and innovative users that are close to each other, i.e. within walking distance. High level internal trust, friendly and like-minded environments provide easier and more effective knowledge sharing in tacit form. The negative outcome of this phenomenon is expressed in "not having dedicated organization memory". Authors proposed SEI model that can be considered as a special case of the

general SECI model of knowledge conversion (Nonaka et al., 2005). The "Combination" mode that related to the lack of "explicit to explicit" knowledge conversions due to limit of resources (money, people, time,) in start-ups was neglected. The authors found that exploratory prototyping and systematic representation was the main means that provided conversion of "tacit to explicit" knowledge in "Externalization". The research revealed that conversion "explicit to tacit" knowledge in "Internalization" occurred effectively in combination of explicit knowledge obtained in exploratory prototyping inside of start-up and the knowledge generated by generative AI at the requests of a startup.

4.2.2 Using external sources of knowledge

Start-ups are resource constrained and cannot spend efforts inside to create in full needed knowledge. They are looking for knowledge outside the venture. Universities, research centers, suppliers, business partners and other stakeholders are sources of external knowledge for start-ups. One of them is innovative users, with them a startup can acquire knowledge and enrich team with additional knowledge. Social media, professional communities and now generative AI are external knowledge suppliers for start-ups. Given that a start-up is a relationship business, the relationships (Pellicano et al., 2016) as a socio-economic phenomenon are increasingly important element in knowledge management.

4.2.3 Human-centered management

Knowledge in start-ups is created, shared/transferred, and applied by people by use of face-to-face and online meetings, workshops, training observations, and collaborative activities with stakeholders. Start-ups use technology mostly limited of simple automation of the process. Start-ups put knowledge generated into practice immediately, don't put it on a dusty shelf. Start-up teams check the received solution and finalize it without delay with new portion of knowledge and learning iterating "hypothesis – build – measure – learn – new hypothesis" in feedback loop.

4.3 Knowledge management challenges in start-ups

The study revealed the challenges of KM implementation in the research sample of start-ups.

4.3.1 Lack/primitive of KM system

Four start-ups in the research sample didn't have and six had primitive KM system, which had very high risks of start-up knowledge loss. Nowadays start-ups highly depend on social messaging tools, such as Telegram/WhatsApp to communicate and generative AI services, such as ChatGPT, to find valuable information and new knowledge.

4.3.2 Lack/primitive of KM procedure

The start-ups are new ventures, and their business processes and procedures are primitive, or not well established yet. This also concerns KM. Respondents told us that they did not think that KM procedures were a top priority for a start-up, given the other commitments already made by new venture. Based on the survey, only two start-ups had managed their knowledge at the strategic level. Other startups had no KM strategies at all. And that was one of the main reasons that KM did not well support the start-up business and why they couldn't take good advantage of knowledge assets.

4.3.3 Lack of resources (money, time, people, etc.)

Start-ups are lacking resources always, such as budget, talents, and time. Some of the examined companies considered that their priorities were development and growth. They had to invest such limited resources in more critical tasks rather than just focus and allocate them to KM. Somebody thought that KM was an advanced management activity that did not match current status of business start-up, i.e. "...the time has not yet come, we will return to this when we have more resources...".

4.3.4 Lack of information/knowledge about KM

The majority of respondents demonstrated understanding of the importance of knowledge in business practice. But the real awareness of 1/3 of the respondents were at a low level and they did not have chance to take advantage of KM to increase their business competitive advantages. Respondents often confused the concepts of data, information and knowledge. In many cases the fragmented understanding of the importance of tacit knowledge and insights for innovation design was discovered. In some cases, the focus was on the selective knowledge areas and cumulative set of knowledge in different domains did not get due

attention. The authors revealed this in the research and proposes study, the necessary knowledge set for start-up, see 4.1 "Knowledge set for start-up".

4.3.5 Knowledge loss with leaving of owner of key knowledge.

Taking into account the fact that the system of knowledge storage is not developed in start-ups, tacit knowledge might be in the mind of a limited number of members of the technology start-up team. Authors revealed that the leaving of a team member who was the owner of key knowledge needed for the product design or any activities in a start-up, brings problems and can even be fatal for a start-up. This situation with a technology start-up differs significantly from a similar situation in a large company or SME, where leaving specialist with certain competencies is replaceable.

5 Conclusions

The exploratory qualitative research was conducted with 27 cross-functional start-up teams in a period 2019-2023. The research revealed the necessary knowledge set for start-ups which facilitated entrepreneurial teams to launch new ventures, to design products and business models by using human-centered knowledge management framework that included social-based and technology-based parts for acquisition, creation, sharing/transferring, and application of tacit and explicit knowledge in start-up. Start-up was defined as a temporary organization designed to validate the hypotheses of MVPs and BMs. The study identified specific set of peculiarities of KM in start-ups, such as 3-mode SEI knowledge conversion model, external sources of knowledge, human-centred management. The study revealed the challenges of KM implementation in start-ups. The limitation of the study is related to limited sample size. At the next step, we plan to study human-centered knowledge management framework in more details with influence of exploratory prototyping and generative AI (ChatGPT) on knowledge acquisition and sharing in start-ups.

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Fast Fashion Brands and Environmental and Social Sustainability: Knowledge Management as a Moderator

Farzad Sabetzadeh*

Faculty of Business,
City University of Macau
Taipa, Macau S.A.R, China

Nuo Jane Chen

Faculty of Business,
City University of Macau
Taipa, Macau S.A.R, China

* *Corresponding author*

Abstract

As fast fashion brands expand, society and customers pay more attention to environmental and social sustainability. This study will examine the impact of environmental and social sustainability on customer purchase intentions and the moderating effect of knowledge management strategies on this relationship, based on the general understanding that knowledge management (KM) can be a strategic tool to achieve sustainability and communicate with outside sources. Three hundred and twelve students from mainland China were surveyed. The moderating effect of knowledge management strategies on environmental and social sustainability has been examined through regression analysis. Results confirm that environmental and social sustainability positively impacts customer purchase intentions. The study shows some interesting moderating effects associated with human-focused knowledge management strategies. In this study, the contribution of context-dependent environmental and social sustainability to customer purchase intention is examined, as well as the potential influence. This study also analyzes the contribution of context-dependent environmental and social sustainability to customer purchase intention as a knowledge management strategy.

Keywords – Environmental sustainability, social sustainability, Technology-focused KM strategy, human-focused KM strategy, Customer. Purchase intention.

Paper Type - Academic Research Paper

1 Introduction

1.1 Research background

The fast fashion industry can be defined as a business that leads by fashion and reduces the processes involved in the customer buying cycle, which makes getting new products into a store in a very "fast" way to satisfy consumer demand at a peak level (Barnes & Lea-Greenwood, 2006). Successful fast fashion brands are famous for frequently renewing and updating their product line. The rise of fast fashion brands such as UNIQLO, Zara, MUJI, and H&M in the multinational market is characterized by shorter Production Life Cycles (PLC), lower prices, and increasing fashion cycles with accusations about pollution, and high humanitarian concerns (Wei & Jung, 2022). These ethical compromises humiliate the image of fast fashion brands.

According to the value-belief-norm theory (VBN), customers have an ethical concern and environmentally friendly tendency when evaluating consumer value and consumer intention (Fauzi et al., 2022). Customers become increasingly aware of fashion brands' social and environmental sustainability, impacting their purchase intention (Stringer et al., 2020).

Knowledge management (KM) is a proper approach for fast fashion brands to achieve environmental and social sustainability goals. A consensus from the literature review is that KM is a systematic tool for creating, storing, and sharing knowledge within and around a company (Rowley, 1999). The benefit of establishing an appropriate KM strategy for fast fashion brands can be enhanced in customer relationship management (CRM) and management information systems (MIS) when it is a moderator between sustainability and purchase intention. (Gebert et al., 2003)

The Resource-Based View (RBV) study defined KM as intellectual capital management (Rehman et al., 2021). Organizational knowledge management systems (OKMS) present a potential for KM to mediate between environmental and social sustainability and customer purchase intention (Meso & Smith, 2000).

1.2 Research objectives

Considering the inconsistency between environmental and social sustainability-purchase intention in global fast fashion brands, this study aims to find the

relationship between environmental and social sustainability and customer purchase intention on fast fashion items and the potential moderating effect of KM strategy.

One objective of this study is to examine the effects of environmental and social sustainability on consumer purchase intention. Considering the fast fashion industry, two environmental and social sustainability practices (animal welfare and over-produced pollution, worker welfare and charity activity, respectively) and the level of purchase intention were applied to test the hypothesis.

The other objective is to investigate the possible moderating role of KM strategy in influencing environmental and social sustainability on customer purchase intention. Two forms of KM strategy — technology-focused and human-focused (Ling, 2019)- are based on RBV as a moderator between environmental and social sustainability and customer purchase intention.

2 Theoretical Background and hypothesis development

2.1 Theoretical framework

The prior step can be understood as environmental and social sustainability to envisage the research framework better. In contrast to sustainable development focused on the macro-level, environmental and social sustainability stand at the micro-level of the organization (Durst & Zieba, 2020). Environmental and social sustainability practices can be associated with environmental and social issues caused by them. While the fast fashion industry expanded to more than US $21 billion in 2021, encouraging over-consumption with over-production becomes one of the most severe unsustainable and unethical issues to be criticized. Another environmental issue — animal abuse can track back to the 1980s with an anti-fur campaign (Stringer et al., 2020). These days, fast fashion brands must be concerned about animal welfare to balance the ethical brand image and product value when launching a product. For social issues, since most fast fashion clothing can be seen as a labor-intensive industry, the manufacturing plants typically locate in developing countries. Workers' welfare concerns customers, including working conditions and minimum wage rate, and may impact purchase intention. Also, nowadays, the charity activities held by a company can be one of the most direct standards by which customer judge the social sustainability.

KM is a traditional way to help implement environmental and social sustainability and make customers see the outcome. An organized KM supports the right people can get the proper knowledge at a suitable time to enhance productivity, shortens the supply chain to save resources, and demonstrates the appeal of human resources (Evangelista & Durst, 2015). On the other hand, KM can be a good tool used in CRM to continuously show that the fast fashion brand has excellent and ethical behavior toward their customer and improve purchase intention. Two kinds of KM strategies may use in this process:

(1). technology-focused KM strategy: emphasizes the management of knowledge using information technology such as big data and IT systems or intellectual capital management such as enterprise search systems and text analytic tools.

(2). human-focused KM strategy: emphasize the management of knowledge utilizing human resources such as communication in customer services.

So based on the explanation above explanation, the research model is to test if environmental and social sustainability can influence the level of purchase intention and if KM strategy played a moderator when it is combined with environmental and social sustainability, as shown in Figure 1.

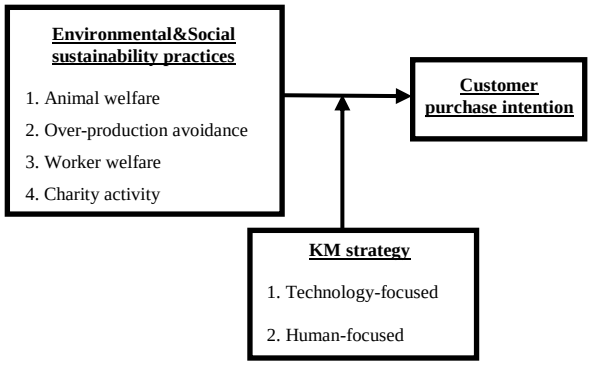

Figure 1. Research Framework

2.2 Hypothesis Testings

Four types of variables will be found in this study - 1. Independent variables (IV), that is, four environmental and social sustainability practices include animal welfare, over-production avoidance, worker welfare, and charity activity. - 2. Dependent variables (DV) are the degree of customer purchase intention. - 3.

Moderating variables (MV), a second independent variable believed to affect IV-DV, KM strategies used in the process significantly. - 4. control variables (CV), i.e., irrelevant variables, refer to the variables that may affect the IV-DV, but the effect is not at the core of the problem studied, including the economic condition or consumption trend

To find the possible relationship between IV-DV, a study in 2022 Shows that sustainability claims have adverse effects on brand management and further decrease purchase intention. As the hypothesis in Table 1 outlines, environmental and social sustainability may enhance a purchase intention.

Table 1. Environmental and social sustainability impact on purchase intention

H1	While environmental and social sustainability tends to positively associate with customer purchase intention, diverse sustainability practices' contribution to purchase intention will differ.
H1.1	Practices on over-production avoidance are more possibly to associate with customer purchase intention positively.
H1.2	Practices on animal welfare are more possibly to associate with customer purchase intention positively.
H1.3	Practices on worker welfare are more likely to positively associate with customer purchase intention.
H1.4	Practices on charity activity are more likely to positively associate with customer purchase intention.

Technology-focused knowledge management strategies are required to better understand moderating variable (MV) 's influence and transfer sustainability knowledge to customers to generate a green and ethical brand image. In the human-focused KM context, better corporate social responsibility (CSR) and community relations may act as moderating factors. (Table 2)

Table 2. Technology-focused and Human-focused KM Strategy Hypothesis

H2	KM strategy is the moderation between environmental and social sustainability and purchase intention.
H2.1	Technology-focused KM strategy will have a favorable moderation effect between environmental practices (over-production avoidance and animal welfare) and customer purchase intention.
H2.2	Human-focused KM strategy will have a favorable moderation effect between environmental practices (over-production avoidance and animal welfare) and customer purchase intention.
H2.3	Technology-focused KM strategy will have a favorable moderation effect between social practices (worker welfare and charity activity) and customer purchase intention.
H2.4	Human-focused KM strategy will be a favorable moderation between social practices (worker welfare and charity activity) and customer purchase intention.

3 Methodology

3.1 Data collection

Since university students are the most important buyers of fast fashion brands, they will be the study's target population. The sample of this study was collected from 414 university students in mainland China, and 312 of these responses are considered effective. The questionnaire items were designed in a standardized form. A five-point Likert Scale was extended to measure the level of sustainability fast fashion brands expected to achieve and the strength of their purchase intention.

Table 3 shows descriptive statistics of the data collected, including the sample size and the maximum, minimum, mean, and standard deviation of each item. As illustrated in the table, each item is a relatively modest value.

Table 3. Sample Descriptive Statistics

Variable	Sample	Maximum	Minimum	Mean	Standard deviation
Pollution avoidance	312	5	1	3.561	1.041
Animal welfare	312	5	1	3.683	1.096
Worker welfare	312	5	1	3.647	0.994
Philanthropy	312	5	1	3.718	1.05
KM 1	312	5	1	3.526	0.938
KM 2	312	5	1	3.532	1.017
Purchase intention	312	5	1	3.558	1.022

3.2 Measurements

3.2.1 Validity and Reliability

To assess validity and relevancy, we used a correlation coefficient to review the questionnaire items to ensure the respondents could understand the research questions and that the data we collected were valid. The finding suggests that environmental and social sustainability and KM are related to customer purchase intention to fast fashion products. Table 4 shows the result of the correlation analysis.

To examine the validity, we use the model of Pearson correlation analysis. The correlation results provide definitive evidence of a good appropriacy to the data, indicating the construct validity to be acceptable. It confirms that purchase intention coincides with environmental and social sustainability, including four dimensions, pollution avoidance (r=0.597, p=0.000***), animal welfare (r=0.58, p=0.000***), worker welfare (r=0.583, p=0.000***), and Philanthropy (r=0.551, p=0.000***), KM strategies including two dimensions, technology-focused (r=0.568, p=0.000***) and human-focused (r=0.493, p=0.000***).

Based on the above results, the study enjoys a relatively high internal consistency; all variables fall over 0.4-0.7 intervals. (Table 4)

Table 4. Correlation Analysis for Sample Data

	Purchase intention
Pollution avoidance	0.597(0.000***)
Animal welfare	0.58(0.000***)
Worker welfare	0.583(0.000***)
Philanthropy	0.551(0.000***)
Technology-focused KM	0.568(0.000***)
Human-focused KM	0.493(0.000***)
Purchase intention	1(0.000***)

Note: ***、**、*represent the significant level of 1%、5%, 10%, respectively.

3.2.2 Regression Analysis

Regression analyses were then applied to verify the main effect of environmental and social sustainability on purchase intention and the moderating effect of KM strategies in the association. Table III shows the impact of four environmental and social sustainability actions on customer purchase intention.

It is found as shown in Table 5, that environmental and social sustainability positively contributes to customer purchase intention of fast fashion products. Concerning the influence of pollution avoidance, model 1.1 shows a significant positive effect (β=0.586, t=13.091), indicating that pollution avoidance has a positive association with purchase intention. Concerning the influence of animal welfare, model 1.2 shows a significant positive effect (β=0.541, t=12.547), indicating that animal welfare has a positive association with purchase intention. Concerning the influence of worker welfare, model 1.3 shows a significant positive impact (β=0.6, t=12.648), indicating that worker welfare has a positive association with purchase intention. Concerning the influence of philanthropy, model 1.4 shows a significant influence coefficient (β=0.536***, t=11.632), indicating that philanthropy has a positive association with purchase intention. H1 is supported by confirming that environmental and social sustainability positively contributes to purchase intention. *H1.1*, *H1.2*, *H1.3,* and *H1.4* are also supported.

Table 5. Regression Analysis Based on Sample Data

	Model 1.1	Model 1.2	Model 1.3	Model 1.4
Pollution avoidance	0.586***			
	13.091			
Animal welfare		0.541***		
		12.547		
Worker welfare			0.6***	
			12.648	
Philanthropy				0.536***
				11.632
Constant number	1.471	1.564	1.369	1.563
	8.857	9.439	7.634	8.777
R^2	0.356	0.337	0.34	0.304
Adjusted R^2	0.354	0.335	0.338	0.302
F Value	F=171.368 P=0.000***	F=157.44 P=0.000***	F=159.982 P=0.000***	F=135.3 P=0.000***

Note: ***、**、*represent the significant level of 1%、5%、10% respectively.

Concerning the moderation role of the two KM strategies, Table 6 lists the sustainability-purchase intention association. The figures show that the technology-focused KM strategy combined with environmental and social sustainability does not significantly impact customer purchase intention. Overall, the technology-focused KM strategy as a moderator does not hold a considerable effect, which means H2.1 and H2.3 are not significant and not supported.

Table 6. Moderation Effect of Technology-Focused Strategy

	Model 2.1			Model 2.2			Model 2.3		
	Parameter	t	P	Parameter	t	P	Parameter	t	P
const	1.471	8.857	0.000***	0.914	4.993	0.000***	0.789	1.513	0.131
Pollution avoidance	0.586	13.091	0.000***	0.355	5.978	0.000***	0.426	2.918	0.004***
KM 1				0.391	7.305	0.000***	0.393	2.461	0.014**
Pollution							-0.01	-	0.798

avoidance×KM 1			0.256
R^2	0.356	0.423	0.423
Adjusted R^2	0.354	0.419	0.417
F	F(312, 1)=171.368，P=0.000***	F(2, 309)=113.15，P=0.000***	F(3, 308)=75.227，P=0.000***
△R^2	0.356	0.423	0.423
△F	△F(1, 312)=171.368，P=0.000***	△F(1, 309)=35.733，P=0.000***	△F(1, 308)=112.874，P=0.000***

Note: ***、**、*represent the significant level of 1%、5%、10% respectively.

	Model 2.4			**Model 2.5**			**Model 2.6**		
	Parameter	**t**	**P**	**Parameter**	**t**	**P**	**Parameter**	**t**	**P**
const	1.564	9.439	0.000***	0.846	4.583	0.000***	1.058	2.037	0.043**
Animal welfare	0.541	12.547	0.000***	0.393	7.071	0.000***	0.304	2.197	0.029**
KM 1				0.36	7.579	0.000***	0.327	2.026	0.044**
Animal welfare×KM 1							0.017	0.437	0.662
R^2	0.337			0.429			0.43		
Adjusted R^2	0.335			0.425			0.424		
F	F(312, 1)=157.44，P=0.000***			F(2, 309)=116.161，P=0.000***			F(3, 308)=77.302，P=0.000***		
△R^2	0.337			0.429			0.43		
△F	△F(1, 312)=157.44，P=0.000***			△F(1, 309)=49.998，P=0.000***			△F(1, 308)=116.048，P=0.000***		

Note: ***、**、*represent the significant level of 1%、5%、10% respectively

	Model 2.7			**Model 2.8**			**Model 2.9**		
	Parameter	**t**	**P**	**Parameter**	**t**	**P**	**Parameter**	**t**	**P**
const	1.369	7.634	0.000***	0.843	4.44	0.000***	0.423	0.766	0.444
Worker welfare	0.6	12.648	0.000***	0.369	6.153	0.000***	0.497	3.399	0.001***
KM 1				0.388	6.854	0.000***	0.502	2.868	0.004***
Worker welfare×KM 1							-0.033	-0.809	0.419
R^2	0.34			0.412			0.414		
Adjusted R^2	0.338			0.409			0.408		

F	F(312, 1)=159.982，P=0.000***	F(2, 309)=108.429，P=0.000***	F(3, 308)=72.423，P=0.000***
$\triangle R^2$	0.34	0.412	0.414
△F	△F(1, 312)=159.982，P=0.000***	△F(1, 309)=37.856，P=0.000***	△F(1, 308)=108.963，P=0.000***

Note: ***、**、*represent the significant level of 1%、5%、10% respectively

	Model 2.10			**Model 2.11**			**Model 2.12**		
	Parameter	**t**	**P**	**Parameter**	**t**	**P**	**Parameter**	**t**	**P**
const	1.563	8.777	0.000***	0.924	4.838	0.000***	0.655	1.26	0.209
Philanthropy	0.536	11.632	0.000***	0.407	6.824	0.000***	0.395	2.822	0.005***
KM 1				0.323	6.063	0.000***	0.49	3.044	0.003***
Philanthropy ×KM1							-0.021	-0.557	0.578
R^2	0.304			0.395			0.396		
Adjusted R^2	0.302			0.391			0.39		
F	F(312, 1)=135.3，P=0.000***			F(2, 309)=100.882，P=0.000***			F(3, 308)=67.208，P=0.000***		
$\triangle R^2$	0.304			0.395			0.396		
△F	△F(1, 312)=135.3，P=0.000***			△F(1, 309)=46.573，P=0.000***			△F(1, 308)=100.967，P=0.000***		

Note: ***、**、*represent the significant level of 1%、5%、10%, respectively

Concerning human-focused KM strategy, Tables 7 show the effect of human-focused KM strategy as a moderator among the sustainability-purchase intention association. As Table 7 shows, human-focused KM strategy as a moderator plays a significant role in social and environmental sustainability-purchase intention association. Specifically, human-focused KM strategies in environmental sustainability positively contribute to customer purchase intention, including pollution avoidance (β=0.075，t=1.928) and animal welfare (β=0.142，t=3.829). Specifically, human-focused KM strategies in social sustainability, including worker welfare (β=0.134，t=3.336) and Philanthropy (β=0.129，t=3.259), positively contribute to customer purchase intention. Overall, the human-focused KM strategy as a moderator has significant effects, especially with pollution avoidance, which means H2.2 and H2.4 are substantial and supportive.

Table 7. Moderation Effect of Human-Focused Strategy

	Model 2.13			Model 2.14			Model 2.15		
	Parameter	**t**	**P**	**Parameter**	**t**	**P**	**Parameter**	**t**	**P**
const	1.471	8.857	0.000***	1.086	5.938	0.000***	2.03	3.884	0.000***
Pollution avoidance	0.586	13.091	0.000***	0.238	4.469	0.000***	0.195	1.333	0.184
KM 2				0.458	8.811	0.000***	-0.045	-0.286	0.775
Pollution avoidance*KM 2							0.075	1.928	0.055*
R^2	0.356			0.395			0.402		
Adjusted R^2	0.354			0.391			0.396		
F	F(312, 1)=171.368，P=0.000***			F(2, 309)=100.915，P=0.000***			F(3, 308)=69.106，P=0.000***		
$\triangle R^2$	0.356			0.395			0.402		
$\triangle F$	$\triangle$F(1, 312)=171.368，P=0.000***			$\triangle$F(1, 309)=19.974，P=0.000***			$\triangle$F(1, 308)=105.517，P=0.000***		

Note: ***、**、*represent the significant level of 1%、5%、10% respectively

	Model 2.16			Model 2.17			Model 2.18		
	Parameter	**t**	**P**	**Parameter**	**t**	**P**	**Parameter**	**t**	**P**
const	1.564	9.439	0.000***	1.204	6.589	0.000***	2.92	6.053	0.000***
Animal welfare	0.541	12.547	0.000***	0.235	4.207	0.000***	-0.05	-0.379	0.705
KM 2				0.414	7.991	0.000***	-0.316	-2.055	0.041**
Animal welfare*KM 2							0.142	3.829	0.000***
R^2	0.337			0.373			0.401		
Adjusted R^2	0.335			0.369			0.395		
F	F(312, 1)=157.44，P=0.000***			F(2, 309)=91.811，P=0.000***			F(3, 308)=68.803，P=0.000***		
$\triangle R^2$	0.337			0.373			0.401		
$\triangle F$	$\triangle$F(1, 312)=157.44，P=0.000***			$\triangle$F(1, 309)=17.701，P=0.000***			$\triangle$F(1, 308)=110.536，P=0.000***		

Note: ***、**、*represent the significant level of 1%、5%、10% respectively

	Model 2.19			Model 2.20			Model 2.21		
	Parameter	**t**	**P**	**Parameter**	**t**	**P**	**Parameter**	**t**	**P**
const	1.369	7.634	0.000***	1.088	5.732	0.000***	2.769	5.152	0.000***
Worker welfare	0.6	12.648	0.000***	0.222	3.887	0.000***	0.01	0.067	0.947
KM 2				0.463	7.931	0.000***	-0.3	-1.805	0.072*
Worker welfare*KM 2							0.134	3.336	0.001***
R^2	0.34			0.371			0.393		
Adjusted R^2	0.338			0.367			0.387		
F	F(312, 1)=159.982，P=0.000***			F(2, 309)=91.187，P=0.000***			F(3, 308)=66.494，P=0.000***		
$\triangle R^2$	0.34			0.371			0.393		
$\triangle F$	$\triangle F(1, 312)=159.982$，P=0.000***			$\triangle F(1, 309)=15.111$，P=0.000***			$\triangle F(1, 308)=105.305$，P=0.000***		

Note: ***、**、*represent the significant level of 1%、5%、10% respectively.

	Model 2.22			Model 2.23			Model 2.24		
	Parameter	**t**	**P**	**Parameter**	**t**	**P**	**Parameter**	**t**	**P**
const	1.563	8.777	0.000***	1.241	6.538	0.000***	2.832	5.418	0.000***
Philanthropy	0.536	11.632	0.000***	0.247	4.183	0.000***	-0.008	-0.058	0.954
KM 2				0.388	6.78	0.000***	-0.291	-1.662	0.098*
philanthropy*KM 2							0.129	3.259	0.001***
R^2	0.304			0.341			0.363		
Adjusted R^2	0.302			0.337			0.357		
F	F(312, 1)=135.3，P=0.000***			F(2, 309)=79.999，P=0.000***			F(3, 308)=58.534，P=0.000***		
$\triangle R^2$	0.304			0.341			0.363		
$\triangle F$	$\triangle F(1, 312)=135.3$，P=0.000***			$\triangle F(1, 309)=17.497$，P=0.000***			$\triangle F(1, 308)=93.111$，P=0.000***		

Note: ***、**、*represent the significant level of 1%、5%、10%, respectively.

4 Conclusion

This research inspects the impact of environmental and social sustainability and KM strategies on customer purchase intention in the fast fashion industry. The study verifies context-based environmental and social sustainability and moderating effects of KM strategies among environmental and social sustainability and customer purchase intention.

As for managerial implication, this research provides possible guidelines for fast fashion brands to enhance the purchase intention of their major consumers in mainland China. The results suggest that sustainability actions can positively increase customer purchase intention and create value. Also, this research gives an idea of sustainability-KM to propagate the company's sustainability efforts to potential customers to give them a good impression of the brands and further contribute to a purchase decision. And the alignment of human-focused KM sustainability can be considered a better alignment that probably has an amazing contribution to enhancing purchase intention. As a result, fast fashion brands should pay more effort into delivering their effects on KM in human resources and CRM.

The current research is not without limitations. For instance, the region and population we collected sample are limited to mainland China university students, respectively. Also, the research takes the whole fast fashion industry as the subject to find the impact of environmental and social sustainability on customer purchase intention and the moderation role taken by KM strategy. In fact, many brands are involved in the fast fashion industry. Different brands have various conditions which make environmental and social sustainability has a different level of influence on the customer purchase intention of each specific brand. Also, the moderating effect should be reconsulted in case of a particular fast fashion brand.

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Digital Platform for Knowledge Sharing and Value Co-Creation in Waste Recycling: The Case of Alpha

Angelo Paletta

Department of Management
University of Bologna
Via Capo di Lucca, 34, 40126, Bologna, Italy

Selena Aureli

Department of Management
University of Bologna
Via Capo di Lucca, 34, 40126, Bologna, Italy

Luigi Mersico*

Department of Management
University of Bologna
Via Capo di Lucca, 34, 40126, Bologna, Italy

** Corresponding author*

Abstract

This paper aims to investigate the role of digital platforms in improving knowledge sharing and the effectiveness of waste recycling by co-creating value. In order to do so, this research undertakes a single qualitative case study focusing on Alpha, a small-sized digital platform provider that operates in the highly fragmented Italian market of waste management.
The case analysis relies on the Resource Interaction Approach as main analytical framework since it provides a practical tool - the 4R model - to classify resources involved and value outcomes emerging from their integration.
Findings show how the digital platform fosters recycling practices engaging citizens, municipalities, and waste management companies in a shared co-production program. They support the literature on digital platforms serving value co-creation processes. The platform acts as a circularity broker between various stakeholders with complementary goals having a different impact on the process and outcomes of value co-creation.

Keywords – Circular economy, Waste management, Recycling, Digital platforms, Value co-creation

Paper type – Academic Research Paper

1 Introduction

While being aware that Circular Economy (CE) and the European Waste Hierarchy (Directive 2008/98/EC) prioritizes waste prevention to reduce environmental impacts, it is acknowledged that most products end up landfilling or incineration after usage (Egüez, 2021; Statista 2023a). Therefore, recycling is undoubtedly a necessary component of CE and represents a sustainable strategy that the European Union aims to increase as demonstrated by the so called "circular economy package" adopted by the European Parliament on April 18th, 2018, which imposes binding targets for municipal waste recycling. Data indicate that the overall recycling rate of municipal waste in European Union increased from 27% in 2000 to 47% in 2020 (Statista, 2023b).

Recycling is a process that involves different value chain actors (e.g., waste generators, waste collectors, logistic companies, sorting plants and waste management facilities). In Europe we often find large and vertically integrated waste management companies, which are in charge of collecting, transporting and processing waste. These companies are increasingly investing in digital technologies to implement more cost-effective solutions for waste treatments compared to traditional methods (Eionet Report, 2020; World Bank, 2022).

In recent years, Industry 4.0's key enabling technologies have driven significant advancements in waste management, moving beyond the traditional focus on mechanical technology for waste collection, transportation, sorting, treatment, recycling, or incineration (Ranjbari et al., 2021). New technologies such as sensor-equipped smart bins, robotic automation, semi-autonomous trucks, and artificial intelligence are being increasingly used in waste management for optimized waste collection, transportation, sorting, and recognition and separation of waste materials (Sarc et al., 2019; Borchard et al., 2022; Khadke et al., 2021).

However, the waste management sector seems still struggling in implementing CE processes such as recycling because it suffers from poor collaboration among the different actors involved along the value chain (see Figure 1). Knowledge silos, lack of data compatibility and poor architectural interoperability are the main barriers that hinder the integration of knowledge from different actors and domains and do not allow for the activation of learning mechanisms necessary for improving recycling effectiveness and efficacy (Esmaelian et al., 2018; Cohen and Gil, 2021).

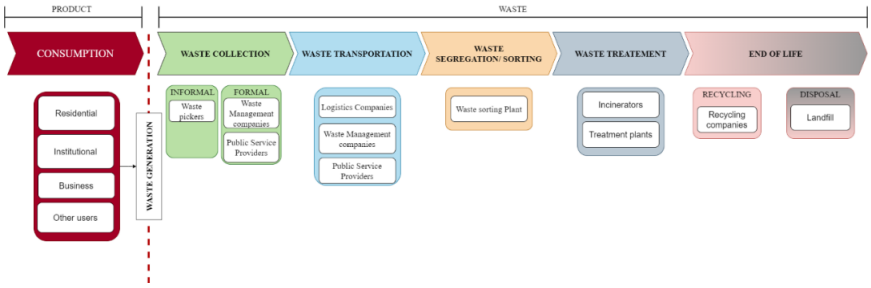

Figure 1. Waste Value chain

With respect to this issue, digital platforms represent both a promising new technology and ecosystems that allow to close the economic circle (De Reuver et al., 2018; Khadke et al., 2021). Often based on reliable peer-to-peer models, digital platforms can support the implementation of CE practices in the waste management sector by enabling knowledge sharing and cooperation among various stakeholders, including municipalities, waste management companies, and citizens (Chauhan et al., 2022; Ferreira et al., 2022).

However, the detailed role of digital platforms in developing more effective waste management services is still poorly investigated. Empirical research is necessary to understand which aspects or resources make a digital platform successful in this specific sector where different types of actors, both public and private, businesses and citizens play an active role. Coherently, we formulated our first research question as follows:

> *How do digital platforms favour knowledge sharing useful for enhancing waste recycling?*

In addition, academic literature indicates that interactions allowed by digital platforms may contribute to the process of value co-creation in many public service ecosystems (Petrescu et al., 2019) as they allow implementing strategies that combine online and offline activities in a single co-production program (Mu et al., 2022). Municipal waste management and recycling is a public service necessary to protect public health, where value co-creation represents a crucial factor for improvements, but research reported many difficulties that prevent the development of co-creation processes as in the case of Swedish waste management industry (Svingstedt and Corvellec, 2018). Therefore, we formulated our second research question as follows:

> *How does knowledge sharing via digital platforms contribute to co-creating value?*

In order to address these research questions, we conduct an explorative analysis of a single case study (Yin, 1994) regarding Alpha, an innovative small-sized firm that has developed a digital platform aimed to i) support households to correctly sort their waste and ii) connect municipalities, waste management companies, and citizens. The company, based in Emilia-Romagna region (Italy), has been chosen to provide the perspective of a service provider operating since 2015 across 1600 Italian municipalities in a national context characterized by the highest recycling rate in Europe (Statista, 2023c) despite the great fragmentation of waste management companies and many different local rules for waste sorting (Sarra et al., 2017).

Drawing on primary data collected through an open-ended interview with two key managers, the empirical analysis relies on the Resource Interaction Approach (RIA) (Baraldi et al., 2012) as main analytical framework. The RIA approach has been adopted as it provides a practical tool named the 4R model (Hauke-Lopes et al., 2022), which represents a suitable framework to explore how value arises when different actors deploy resources in terms of technology, knowledge, information, skills and experience within a value creation process (Gerbauer et al., 2010).

Findings contribute to the literature on the role of digital platform in waste management (Frempong et al., 2018) by fostering the discussion on how waste recycling can benefit from the use of digital platforms (Kurniawan et al. 2022) as resource integrators. More broadly, findings also contribute to the literature on the role of digital technology in supporting the implementation of CE (Liu et al., 2022; Abbate et al., 2023).

2 Literature background

2.1. Digital platforms, circular economy and supply chains

Research suggests that the creation of solutions to sustainability-related problems requires system thinking, which in turns calls for the assembly of different knowledge and perspectives (Elia & Margherita, 2018) and collaboration across upstream and downstream supply chain actors (de Bas et al., 2017). Similarly, CE requires interaction between groups of users with complementary needs, which can be facilitated by digital platforms (Ciulli et al., 2020; Charnley et al., 2022; Rejeb et al., 2023). Recent literature indicates digital platforms as a key

enabler of the CE because they are virtual environments that bridge structural holes between different entities and facilitate collaboration and information sharing (Bressanelli et al. 2018; Blackburn et al., 2022).

In the field of waste management, there is a growing attention on key enabling technologies related to Industry 4.0 in supporting the implementation of CE processes (Sarc et al., 2019). Digital platforms contribute to waste reduction by supporting the sharing of surpluses matching the supply and demand (de Almeida Oroski and Monteiro da Silva, 2022) and blockchain-based platforms create collaborative environments that promote CE (França et al., 2019; Rejeb et al.,2022). By facilitating the sharing of best practices, digital platforms also led to the development of innovative waste management solutions with respect to recycling tasks (Jang et al., 2020) and favored customer engagement in secondhand fashion which contracts textile waste (Charnley et al., 2022).

According to the literature, the platform provider plays a key role. Blackburn et al. (2022) define digital platforms as meta-organizations based on orchestration mechanisms deployed by platform owners to facilitate value creation. In the same vein, Ciulli et al. (2020) focus on orchestration mechanisms between upstream and downstream supply chain actors, their activities and resources. However, there is a lack in discussing the barriers that hinder the full implementation of cooperation practices, especially those regarding the integration of consumers when compared to business entities (Masi et al., 2018; Ciulli et al., 2020).

Yet, consumers involvement is fundamental to promote the adoption of sustainable practices. Digital platforms should focus on the dissemination of knowledge to the downstream of supply chain, fostering the creation of a collaborative and shared learning community and providing useful information and resources. Therefore, we argue that in-depth research is needed for understanding how digital platforms involve consumers as well as other actors to set up a value co-creation process. Value is created from a collaborative process between users and providers of products or services, where they combine pre-existing resources to create new value (Frempong et al., 2020) only if strong relationships and high-quality interactions between organizations and customers are established (Jaakkola and Alexander, 2014).

2.2. Public value co-creation and digital platforms

In managerial literature, the process of value co-creation has been extensively analyzed using the service-dominant logic approach (Vargo et al., 2008). Described as a process that is beneficial to all parties, it is often started by suppliers to gain benefits from the use of consumers' or counterpart's knowledge and skills. This appropriation of value by a private actor is somehow contested in public service environment. A public service like health care, transport, or waste management is organized or controlled by the government or an official body because it shall provide public value, i.e., value to the society (Laitinen et al., 2018; Petrescu, 2019). Services delivering public value are designed to contribute to the common good. Therefore, organizations offering public services need to create something with social legitimacy, political sustainability, and economic feasibility (Dudau et al., 2019).

Scholars investigating the value co-creation within public service production processes describe how citizens, users, and service providers interact in the co-design and co-production phases (Osborne, 2021) and emphasize the shift from organizations as a merely value creators to resource integrators, involving users in the development process through the investment of time, resources, and insights (Frempong et al., 2018; Hollebeek et al., 2019; Landi and Russo, 2022).

In this context, digital platforms represent an opportunity for public managers to gather collective intelligence and improve their service offerings while contributing to positive social impact (Petrescu, 2019). However, studies on the co-creation of public value using digital platforms are still limited. There is a need for in-depth research to understand how the combination and re-combination of technical and organizational/social resources provided by decentralized network actors concur to the creation of value (Hauke Lopes et al., 2022).

3 Methodology

In line with the explorative nature of the study, this paper adopts a qualitative research methodology based on a single case study (Yin, 1994). The methodology was selected due to both the novelty of the research problem and the vagueness of the current theories (Halinen and Törnroos, 2005) on value co-creation and digital platforms in waste management. The paper follows an abductive approach for coding information and elaborating results (Dubois and Gadde, 2002).

The case firm is Alpha, an Italian innovative (according to Italian Law) small-sized enterprise established in 2014, whose main business is software development for waste management. Alpha has been chosen since a) it operates in Italy, which represents a particular context characterized by high geographical fragmentation of waste collection services that hinders efficiency (Sarra et al., 2017); b) its mission is to offer digital solutions that connect waste management companies, municipalities, and households to facilitate waste sorting process (i.e., prevent incorrect sorting of materials at home) and create the virtuous circle of recycling.

Data has been collected through direct semi-structured interviews to two key informants. The semi-structured approach has been chosen in order to guide the direction of the discussed topics. The key figures interviewed are two co-founders of Alpha who differ for backgrounds and responsibilities in business and technical operations respectively. Interviews were conducted in October 2022. Every interview had an average duration of 1 hour and both of them have been recorded and transcribed verbatim. Furthermore, secondary sources like company website, sectorial magazines and press releases were included in the analysis to better assess the setting of the case study and its implications. Information from interviews and secondary sources have been triangulated to examine data consistency (Patton, 1999).

The RIA approach and 4R model (Håkansson and Waluszewski, 2002; Baraldi and Wagrell 2022) have been adopted to understand how resources are combined and re-combined to create new valuable solutions (Hauke-Lopes et al., 2022). The 4R model helps to classify resources into i) technical resources (such as products and facilities), which have material properties, and ii) organizational/social resources (such as organizational units and relationships), characterized by social features and displaying intangible characteristics (Strömsten and Waluszewski, 2012).

Within the 4R model, resource interaction is the interplay between technical resources and organizational resources, which represent technologies, knowledge and relationships (Baraldi et al., 2012). Products are described as artifacts, goods, and services. Facilities concern interdependent technical resources and equipment (plants, logistics, infrastructures, and information systems) used to create products. Organizational units include individuals, internal units, or firms and represent key resources encompassing various intangible elements, such as procedures, skills, experience, knowledge, trust, identity, and reputation. The last

class of resources is relationships, that is, the ties and links created by actors in interaction and mobilized by organizational unit resources.

4 Case Description: The main features of Alpha's digital platform

Alpha is an innovative Italian small-sized enterprise established in 2014 by five friends with strong ICT expertise. It aims to offer cloud-based solutions for the cleantech sector. Its main and only solution currently sold is a digital platform that mainly connects subjects producing waste (citizens, travelers, businesses, etc.) with waste management companies through a mobile App. Since Italy has a high geographic fragmentation in waste collection (i.e., differences are at municipal level) that makes difficult for households to contribute to correct sorting and recycling, the App aims to respond to the information needs of citizens and travelers on how to treat waste.

The digital platform dialogues with the smartphone camera to recognize barcodes of products and GPS functions to geo-localize the camera images. The platform associates the location of the users to the local rules for sorting the materials contained in the product or its packaging. Since the barcode does not report the materials used, Alpha has internally built a product catalogue that classifies materials. This product catalogue is a database currently containing 1.800.000 items. About 25% of them have been signaled by citizens and users that upload information and therefore may strongly contribute to enrich the catalogue. From the co-founder's point of view: "*our platform is an ideal link that connect all the players of the world of urban waste management, where the citizen, however, is the main actor.*"

The information on waste sorting is provided by municipalities and/or waste management companies that have to pay a subscription fee. While the App is free for users, both municipalities and waste management companies pay to put the local rules for waste collection and other information they believe useful for citizens and tourists. For example, users may find information on different material-specific waste bins and colours, as well as city maps with collection points (eco-centers, large or dedicated bins, special collections, etc.). The App currently includes 7.500 on a total of 8.000 waste disposal rules set by Italian municipalities. In addition, users may signal sanitary problems to municipalities by simply uploading a picture of abandoned waste or other issues.

In 2017, Alpha also started to implement, in partnership with a high-tech start-up, an Artificial Intelligence system that speeds up the categorization of products and uses algorithms to create new knowledge on products' material composition and its end-of-life management beside the existence of a barcode. Its main aim is to support the citizen in the correct sorting of the waste that has no packaging nor barcode. In the words of one of the co-founders: *"This new functionality represents our shift from packaging to objects"*.

In a nutshell, Alpha's digital platform favour communication among municipalities, waste management companies and citizens/users but also contribute to optimize waste collection processes. This creates a win-win situation for everyone involved in the waste management process. Waste management companies gain in process efficiency and efficacy because they reduce costs for informing citizens, obtain better sorted waste from the households (which means higher quality waste and less controls at waste management plants) and improve their transparency and relationship with citizens. Municipalities have a quick and easy channel to improve collaboration with waste management companies and have less unhappy citizens. Lastly, citizens find answers to their information needs and aspiration to contribute to sustainability.

5 Discussion

Case study evidence suggests that the digital platform represents a circularity broker as it undertakes four different brokerage roles (i.e., connecting, informing, mobilize, integrating) according to Ciulli et al. (2019). Notably, Alpha leveraging cloud-based technology connects different stakeholders involved in the supply chain, also providing a space in which relevant information can be shared, integrated and exchanged by the various actors, thus creating a direct information flow between the brokered parts.

The use of the 4R model as interpretative lens (Baraldi and Waluszewski, 2005; Baraldi and Wagrell, 2022) highlights that the platform performs its brokerage role relying on four types of resources:

1. Products: the product catalogue database classifying products and the database of waste disposal rules of Italian municipalities.
2. Facilities: the graphical user interfaces internally developed by which different actors can dialogue with the platform.

3. Organizational resources: company's computer scientists and the Artificial Intelligence-based system that mimics the work of a business unit.
4. Key relationships with municipalities, waste management companies, and citizens.

In this case, digital resources (i.e., products and facilities), defined as virtually created material resources, interact with non-digital resources (i.e., organizational units and relationships). Such interaction fosters the continuous developments of the service provided by the platform: a valuable solution is emerged (Hauke-Lopes et al., 2022) as outcome of a co-production process.

In this context, a key role is played by knowledge sharing and knowledge processing. Alpha's computer scientists, who possess technical knowledge, skills, and expertise in developing both the databases' infrastructures and graphical user interfaces, could not work alone. Municipalities and waste management companies contributed to the database by sharing their knowledge on disposal rules and other helpful information for citizens. Additionally, citizens helped populate the product catalogue database by scanning images and improving the AI system's object classification accuracy. All these actors can be viewed as organizational units with relevant knowledge. Actors' knowledge exchange has enabled Alpha to recombine both technical, demographic and business knowledge to enhance its services that positively impact on waste recycling effectiveness.

In addition, the digital platform has the merit to activate two key knowledge processing strategies (Sjödin, 2019): open communication and end-user involvement, which help both waste management companies, municipalities and the platform provider make sense of the requirements and demands stemming from all partners involved, which are necessary to secure successful process innovation outcomes**.**

Open communication and end-user involvement favour the integration of data, experience, skills, and knowledge between actors that Alpha has deployed in a gamified co-production process (Helmefalk and Roselund, 2020; Mu et al., 2022). Alpha leverage on these resources to create new resources (new knowledge, new experience) or new configurations of resources (Ciabuschi et al., 2012) finally leading to the co-creation of sustainable value (Botti and Monda, 2020).

Value is created for both individual users (citizens, travelers, small commercial enterprises) and the society at large. The platform supports users in properly

sorting and disposing of waste at the source by providing information on correct procedures, reducing human errors, and simplifying the task of sorting (Emery et al., 2003; Babaei et al., 2015; Landi and Russo, 2022). This increase in users' knowledge about how to handle waste (Handayani et al., 2018) benefits citizens who find satisfaction for their information needs. In other terms public value is created as the digital platform allows public managers to solve the collective needs and aspirations of citizens to participate to more sustainable consumption patterns (Alford and O'Flynn, 2009). Moreover, the platform contributes to creating value at the systemic level by promoting virtuous behaviors that benefit public health and the environment (Landi and Russo, 2022).

6 Conclusion

This study explores the role of digital platforms in improving the effectiveness of waste recycling by sharing knowledge and co-creating value.

The case study investigated shows how a digital platform, acting as a circularity broker (Ciulli et al., 2020), can favour knowledge sharing among different stakeholders (i.e., citizens/users, municipalities, and waste management companies) and lead to value co-creation processes. Notably the study shows as a digital platform for waste management may enable and mediate interactions among different categories of stakeholders. Such direct and indirect interaction among actors help to overcome the barriers related to the existence of supply chain's structural hole (Burt, 2004) co-creating new value through the integration of resources, developed thanks to process of continuous interaction (Corsaro, 2019) between actors with complementary goals, in terms of knowledge against material and non-material rewards (Landi and Russo, 2022).

The case analysis contributes to both the literature on digital platform in waste management (Frempong et al., 2018) and Industrial Marketing and Purchasing (IMP) literature that focuses on resources interaction. For what concerns waste management literature, the study shows how the sector could benefit from the use of digital platforms (Kurniawan et al. 2022) as a bridge between different stakeholders interested in a sustainability and circular economy initiative. In addition, the study contributes to the RIA literature by deepening the categorization of resources within the digital context. In details, it indicates that technical resources, such as databases, cannot be exclusively classified as products or facilities (Mersico et al., 2022). A database is both a product

developed by organizational units using facilities and a facility useful to create or reconfigure products through their deployment by users.

A managerial implication can be formulated at the light of the results of this study. Software houses offering software solutions as a service (SaaS) need to consider both key technical and organizational resources in the phases of design, development and deployment of the platform in order to be competitive in the waste management sector. In this regard, this study has highlighted key variables that need to be considered when designing such an initiative, including the development of technical and organizational resources.

However, this study does not come without limitations. First, as with any case study, it is not possible to generalize the results beyond the context under examination. Secondly, this study focuses on a specific type of digital platform operating in a particular country as Italy. Thus, further research should include different types of digital platforms operating in different contexts.

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Understanding Sustainable Public Administration through Knowledge Formation

Anna-Aurora Kork*

Faculty of Social Sciences
Tampere University
33014 Tampere University, Finland

Lotta-Maria Sinervo

Tampere University
33014 Tampere University, Finland

Harri Laihonen

University of Eastern Finland
P.O. Box 1627
70211 Kuopio, Finland

Nina Lunkka

University of Eastern Finland
P.O. Box 1627
70211 Kuopio, Finland

* *Corresponding author*

Abstract

The article focuses on collective knowledge formation processes in which an understanding of sustainable public administration (PA) is constituted. We turn the perspective from the production of sustainability data to the epistemic aspects of sustainability: to justifications, rationalities, and knowing in the specific context of sustainability management in public organizations. We approach sustainable policymaking as an ambiguous and complex process that requires collective sense-making of what public organization is and desires to be. This process may lead to a reconsideration of organizational identity, especially concerning core values, purpose and expectations of PA. Through a scoping review of the organizational identity literature, we explore what is known about identity construction and identity work in the PA context. The results of this review will provide insights to further analyze what sustainable PA means through the lens of organizational identity. We suggest that, as an ambiguous policy aim, sustainability will describe the new mission of PA and set strategic ambitions for transformation. In public

organizations, identity construction can be used as a tool for collective sense-making and knowledge formation that responds to the critical strategic questions of why PA exists, what it should achieve in the future, and how its tasks are prioritized. The article contributes to sustainability management discussions by linking public and knowledge management studies and extending the understanding of sustainability as a strategic aim in both fields of research.

Keywords – knowledge formation; sustainability information; organizational identity, public administration, policymaking.

Paper type – Academic Research Paper

1 Introduction

Although the objectives of economically, socially, and environmentally sustainable activities have been the subject of societal and scientific debates for decades, it remains unclear how to operationalize these goals in practice. Therefore, researchers, as well as policy practitioners, are struggling with the different political rationales — how to simultaneously pursue ecological, economic, and social goals, and how to make sense and thus ensure sustainable development both at the institutional macro-level policy and at the administrative and organizational levels in public service management. This kind of institutional complexity, with multiple competing rationalities and operational logics (cf. DiMaggio & Powell, 1983; Greenwood et al., 2011; Raynard 2016) related to the sustainability information and knowledge utilization in public administration (PA), and public sector knowledge management more in general, have received relatively little attention in the knowledge management (KM) literature (cf. Currie & Suhomlinova, 2006; Laihonen & Kokko, 2020).

Besides, sustainability has only recently become a conceptual focus of PA (e.g., Fiorino, 2010; Krause et al., 2016; Figueira et al., 2018; Trondal, 2021). Discussions on sustainability in PA have focused on the issues of sustainable development, especially from the perspectives of the environment, development goals, or accounting and reporting for sustainability (e.g., Greco et al., 2015; Hossain, 2018). Prior literature has not widely studied sustainability as an organizational issue. For example, Ball et al. (2009) and Zeemering (2018) stressed the need to understand the sustainability implementation process and its relationship with different aspects of sustainability in management activities and practices. Still, the

foundation of sustainability information as a socially constructed knowledge and existential part of PA, has not been studied so far.

Knowledge formation in sustainable policymaking is a complex process. We argue that the conception of sustainable PA is continuously reinterpreted and redefined through social interaction among multiple stakeholders and in various cycles of policymaking. This knowledge formation process in society is thus fundamentally dialogic and sociopolitical in nature (cf. Whitworth 2014). In this study, we approach public sector KM from the perspective of knowledge formation, where the foundation of sustainable PA is constituted. We explore what sustainable PA means through the lens of organizational identity with the aim to understand how organizational identity work and knowledge formation process reconcile different desires and expectations of PA. As a strategical ambition, sustainability describes the mission of PA: why it exists and what it should achieve in the future.

Our study contributes to public sector KM literature by emphasizing the social process of knowledge formation in sustainable policymaking. First, we turn the focus from sustainability data production to the ontological and epistemic aspects of sustainability in PA: justifications and rationalities that inform planning and implementing sustainable public policies. Second, we argue that as a result of this negotiation process, a conception and the intentions of sustainable PA will emerge and be constantly shaped. Consequently, sustainability reflects the many values, purposes, and identities of PA (Wæraas, 2010; Zalmanovitch, 2014). Different dimensions of sustainability, such as ecological responsibility, social equity, and economic performance, reflect the essence of PA.

The remainder of this article is organized as follows. First, we provide a brief overview of the premises related to knowledge formation in PA and continue by reflecting on this in the context of sustainable policy making. To understand what sustainable PA is and what it aspires to be, we introduce and analyze the literature on organizational identity. The results of this scoping review are then briefly described in section 4. Finally, we will discuss the potential of utilizing the concept of organizational identity as part of framing knowledge formation and its relationship with sustainability policy goals in PA.

2 Knowledge formation of sustainability in policymaking

Sustainable policymaking is a strategic challenge to public management despite technological advances (Milano et al., 2014). Construction and utilization of knowledge for sustainable policy development is a complex process involving politics and multilevel decision-making with collaborative governance efforts. Surprisingly, literature on public sector KM has left the social processes of knowledge formation with little attention. This has led to the dominance of a rationalist-optimist view advocating technical and evidence-based knowledge in policymaking (Laihonen et al., 2023).

Despite the wide acceptance of knowledge as socially constructed, rationalistic approaches such as evidence-based policy and KM tend to dominate the discussion of public sector KM both in theory and in practice. The prevailing KM approaches prioritize data over meaning (Dumay, 2020; Spender, 2014) and fail to address wicked social problems, such as sustainability (Hess & Adams, 2002; Kay, 2011). Traditional knowledge-based problem-solving approaches still focus on the production of more information and sustainability data rather than the actual dynamics of decision-making and politics (Pollitt, 2006; Laihonen & Mäntylä, 2017; 2018). Critics argue that culturally and historically contingent aspects of evidence-informed policymaking and pluralistic views of truth are left uncovered (Sanderson, 2002; Dillard & Yuthas, 2013), with KM literature focused extensively on producing more information to manage 'tame organizational problems' (Dumay, 2020).

While a long history (e.g., Henry, 1974; Wiig, 2002) and an increasing body of recent literature promoting KM in the public sector exist (e.g., Agrifoglio et al., 2021; Dumay et al., 2015; Massaro et al., 2015), not enough attention is paid to the ways public actors constitute their understanding of sustainable PA, and what kind of policy programs, management strategies or practices they expect to lead to a sustainable future. Therefore, we turn the focus of KM to those social processes in which knowledge and understanding of sustainable PA are constituted.

Knowledge formation in PA highlights 1) the interactive and social processes by which the evidence base of sustainable PA is constructed, 2) the relevance of institutional complexity and organizational responses to sustainable development policies, and 3) the meanings that public actors attach to data and information on sustainability. From this, a threefold framework for analyzing knowledge

formation in PA has been suggested (Laihonen et al., 2023). This framework considers knowledge formation as a continuous interplay of institutional complexity, organizational responses, and individual sensemaking and argues that as a result of the process, the mission, goals, and values of PA take shape.

From the knowledge formation viewpoint, the perception of sustainable PA is continuously (re)created through collective sense-making processes bounded by the institutional demands and organizational responses contingent to the prevailing societal circumstances. Sustainable PA is thus enacted by individuals, the members of PA, based on their interpretations and understandings (Weick et al., 2005). Indeed, knowledge formation is an ongoing process (Lunkka et al. 2022), that represents the evidence, values, and objectives of society. More specifically, we assert that in the policymaking context, available sustainability data and information are enriched with the collective expertise and experiences of multiple stakeholders such as policymakers, policy advisors, managers, civil servants, and citizens.

For us, sustainability provides a timely and highly relevant phenomenon to contextualize the analysis of knowledge formation in PA. Sustainability is variously interpreted and valued in different organizational contexts making it challenging to operationalize. Such pluralism is typical for sustainability discourse, but management is often streamlined. This leads us to study the foundation of PA, its role, and the logics of identity, that is, what ultimately defines PA.

3 Methodology

3.1 Research task

We challenge the rationalistic approaches of KM by taking an interpretivist position (Crotty, 1998; Guba & Lincoln, 1989) on how knowledge of sustainable PA is constructed in a politico-administrative context and in organizational processes. We do this by reviewing the literature on organizational identity in PA. As this is a conceptually oriented article, our aim is to analyze how identity building of PA could inform knowledge formation, which defines the priorities that public organizations attach to the policies and strategies dealing with the different societal phenomena..

Instead of a static description of what sustainability is or could be in PA, we strive to understand the elements of the knowledge formation process in which

conception of sustainable PA is constituted. We see sustainability as a profound strategic ambition, that concerns not only the sustainability data processing functions in public management but also transforming PA identity, its values and intentions to respond future policies. Knowledge of sustainability is constructed on many levels of PA, and organizational responses vary in producing the idea of a sustainable PA.

3.2 Data and methods

As far as we know, no previous research has investigated how knowledge formation and identity of PA are connected, and therefore, we started our research journey by carrying out a scoping review (Arksey and O´Malley, 2005; Munn et al., 2018) which aims to uncover how organizational identity in PA context has been studied. The scoping review is useful for identifying gaps, general topics, and concepts used in the research field (Arksey & O'Malley, 2005).

Instead of systematic approach, our preliminary search was conducted in November 2020 from Scopus and Google Scholar with the search string ”organizational identit*” AND ”public administration” OR "public services" OR "public sector". The initial search was intentionally as wide as possible, as our aim here was to gain the general scope of the research field, which could be at later phases then refined and specified more in detail for systematic review purposes (Arksey and O´Malley 2005; Munn et al., 2018). The Scopus search produced 34 articles and Google Scholar 2810 articles. We screened 604 research articles based on titles and language (English), their relevance, and online availability. After reaching saturation and removing duplicates, we obtained 27 articles that were fully read. During this phase, ten articles were excluded because they did not respond to the research task. Thus, our data consisted of 17 articles on organizational identity in the context of PA (Table 1).

4 Identity of Public Administration

The results of the literature review reveal that many studies covered change aspects, which stimulate the identity formulation process as a response either to organizational change or public management reform. Studies on organizational identity in the public sector context show that constructed identities may be both defensive and proactive responses to managerial reforms. Most of the studies were qualitative case studies or conceptual. For instance, higher education

contexts seem to be highly relevant to study how organizational identities are constructed during managerial reforms (e.g., Garcia & Hardy, 2019; Fumasoli et al., 2015; de Boer et al., 2007). The theoretical background of organizational identity lies mainly in organization studies deriving from the fields of management sciences, social sciences and psychology. The topic has only recently become a subject of public management and public administration studies in the 2010s.

Three main approaches to studying organizational identity can be identified according to Rondeaux (2006). **Interpretative (**representations of who we are as organization, multiple contradictory identities involving sensemaking and incremental evolution), **interactionist (**emphasis on membership and collective creation of organization, co-constructed and negotiated identity, acknowledging inter-related groups, interactions and discouces) and **functionalist (**managerial action in building organizational identity, organizing and promotion of "shared" identity, symbolic management). (Rondeaux 2006).

Table 1 Scoping review of organizational identity in public administration context

Authors	Approach	Organizational identity	Context
Bankins & Waterhouse 2019	functionalist	identity construed of external image, management style and individual public service motivation	public sector identity in the labor market (conceptual)
Beech et al. 2008	interactionist, interpretative	identity as dynamic and changeable, inherently complex and constructed through interaction	public sector change (conceptual)
Brunsson & Sahlin-Andersson 2000	interpretative, interactionist	identity as an idea of being special and different from other organizations	public sector reforms (conceptual)
Czarniawska-Joerges 1994	interactionist, narrative	identity construction as a continuous process of narration	public sector organizations, state agencies
de Boer et al. 2007	Interpretative	identity as socially constructed, symbolic and cognitive side of organizations stimulating new ideas, changing attitudes and frames for action.	higher education, reform, university
Fumasoli et al. 2015	functionalist	identity as a flexible risk reducing device in strategic planning multiplicity functions	higher education, university
Garcia & Hardy 2007	Interactionist, interpretative	identities constructed by narratives	higher education, university

Mönkkönen & Puusa 2015	interactionist, narrative	identity as multiple interpretations of organization core characteristics	governmental offices, organization merger,
Palma et al. 2010	functionalist	system of meaning that guide organizational actors' behaviour, providing cohesion and security	public organization of port industry
Reissner 2019	interpretative (interactionist)	identity as members' shared understanding of who they are as an organization, the outcome of collective sensemaking.	public-private partnership
Rondeaux 2006	interpretative, interactionist	identity as a complex, hybrid and constantly evolving perceptions of reality, multiple identities	administration reform, federal public organization
Rondeaux 2014	interpretative interactionist, integrative approach	identity as hybridization, coexistence of different identity rationales and diverse perceptions. Dynamics of identification work	regional administration
Simpson & Hibbert 2008	interpretative	identity construction as a multi-dynamic process in which multiple temporalities	public sector science organizations
Skålén 2004	interactionist	identity as sensemaking that produces identity	reform program of public healthcare authority
Wæraas 2008	functionalist	identity as multiplicity and inconsistent values	public organizations in Norway (conceptual)
Wæraas 2010	functionalist	identity as the ways public organizations represent their value statement	regulative organizations
Zalmanovitch 2014	interpretative (interactionist)	identity as a socially constructed concept of what the organization is or would like to be.	public administration (conceptual)

4.1 Perceptions on organizational identity

The concept of organizational identity has its roots in the work of Albert and Whetten (1985). They defined organizational identity as a construct that members use to describe what is central, enduring, and unique to their organization. Organizational values are also an essential part of organizational identity (Wæraas, 2010). More recently, studies on organizational identity have suggested that identity is not necessarily coherent and stable, but constantly changing, and that organizations can have multiple identities with different values (Wæraas, 2010). Instead of being explicitly established, organizational identity can be understood as a collective understanding shared by organizational actors that

have different perceptions of organizational identity, reflecting what the organization is, what it is becoming, and what it wants to be (see Rondeaux, 2014).

According to de Boer et al. (2007), organizational identity emphasizes the symbolic and cognitive side of organizations and their role in stimulating new ideas, changing attitudes, and new frames for action. Thus, identity is understood as a socially constructed concept of what an organization is or would like to be. The questions that an organization may ask itself include who we are, what kind of organization is this, and what makes us different. Constructing such an identity may include strengthening organizational autonomy, controlling collective resources, constructing boundaries, and defining 'being special' as an organization. According to Zalmanovitch (2014), the socially constructed identity of PA is grounded in the existence of and interaction among three pillars: political interests (what can be achieved), legal (under what structures, limitations, rules), and managerial tools (how it may be attained).

Mönkkönen and Puusa (2015) refer to ambiguity in organizational identity, which implies multiple possible interpretations of organizational core characteristics. Through dialogue, organizational actors can move from groups and practices toward joint action and into a more collective interpretation of their organizational identity. These narratives can act as stories of identity. Czarniawska-Joerges (1994) employed a framework that combines institutional theory with a narrative approach to study organizational identity. Organizational identity is based on the elements of temporality, locality, metaphors, interaction and narratives.. "The central questions are as follows: Who are we? What do we do? Who are we like? The labels from the private sector became metaphors in this specific context" (Czarniawska-Joerges, 1994, 207).

The new public management doctrine has influenced identities of PA. Skålén (2004) concludes that NPM reform initiatives create fluid, heterogeneous, and even conflicting organizational identities rather than a uniform and stable business identity for public organizations. Two types of identities can be discerned: one related to the ways in which organizational actors perceive the organization and other related to the perceptions that the organization is ascribed to others. For him, organizational identity is a metaphor for discussing and analyzing the organization.

Public organizations are characterized by contradictory and inconsistent values and identities. According to Palma et al. (2010), organizational identity refers to

the system of meaning that guides organizational actors' behavior, providing cohesion and security. In public sector organizations, unique characteristics and public identity imply bureaucracy, such as strong hierarchy, rule orientation, and policy dependency (e.g., Brunsson & Sahlin-Andersson, 2000; Palma et al., 2010). Wæraas (2008) discusses the challenges of introducing corporate branding in part of public sector organizational identity and argues that public organizations could benefit more from branding due to inconsistent values and multiple identities, rather than trying to promote one set of values and one identity at the expense of others.

Rondeaux (2014) suggests that the integration of different perspectives on organizational identities can complement each other. Reissner (2019) theorized that organizational identity is the outcome of collective sensemaking processes that connects the organization and its members recursively and ensures that their understanding of the organization matches its purpose and external expectations.

Organizational identity can be a management instrument with multiple functions that responds to changes in the organizational field. Organizational identity acts as a strategic tool for risk management to guide the desired future state of public organizations (Fumasoli et al., 2015). The management is responsible for the communication of the desired identity of the organization, and this vision reflects the way the organization is perceived by others. (Fumasoli et al., 2015.) This may also produce multiple identities with implications for human resource management. Bankins and Waterhouse (2019) characterize organizational identity as consisting of external, intra-organizational, and intra-individual factors, such as organizational external image and reputation, human resources management practices, and public service motivation of employees. Rondeaux (2006) shows that the universal values, mission, and purpose of public organizations are linked to the two identity logics of public service and public managerialism that define the identity of PA.

4.2 Identity construction process

Organizational identity construction can be used to examine how public organizations respond strategically to internal and external expectations, demands, and environmental changes (Fumasoli et al., 2015). Change seems to be a natural condition rather than an extraordinary event in the construction of organizational identity.

Simpson and Hibbert (2008) assert that organizational identity in PA is socially constructed through continuous interaction, traditions, social habits, and performative actions. They argue that identity construction is an emergent and dynamic interplay between the embodied interpretations of traditions and the spontaneous performative actions of organizational actors. Mönkkönen and Puusa (2015) highlighted interactive processes and stressed the meaning of conscious identity work. For them, dialogue and discourse are essential in examining organizational identity construction.

Public management reforms are ways to construct public organizations. Rondeaux (2014) considers organizational identity a prominent issue in public sector reforms and studies how organizational actors experience identity when modernizing PA. Therefore, understanding the environment and multiple perceptions is essential for organizational identification. There is not necessarily an agreement on institutionalized organizational identity, and different alternative organizational identities may coexist within the same organization. Similarly, Garcia and Hardy (2007) concluded that organizational identities are constructed by the narratives of organizational actors. For instance, how individuals talk about themselves, the group they belong to, other groups, their organizations, and other organizations. Through this process, specific individual and organizational identities are formed and different outcomes are achieved.

Reissner (2019) identifies two mechanisms that can help in the organizational identity construction process: 1) relational positioning that draws on possible configurations of institutional logics and associated identity resources, and 2) discursive framing that captures members' hopes and expectations. In addition, de Boer et al. (2007) highlight 1) constructing organizational boundaries such as defining own activities, environments, relations with other organizations, and government; 2) controlling collective resources such as commanding entry and exit and finances; and 3) being special as an organization, such as having a special task or way of working. Features of organizational identity in PA emphasize at the same time the idea of being special and part of general category of public sector organizations (Brunsson & Sahlin-Andersson, 2000). Public organizations have common features, such as autonomy, collective resources, and constructing boundaries. However, they also have characteristics that make them different from others, such as special purpose, competence, resources, or structures as well as culture and history (Brunsson & Sahlin-Andersson 2000).

Palma et al. (2010) see that following the NPM, a split between operational and strategic control has taken place. and as a result organizational mission is transformed into a more business-oriented mission. This has a significant impact on operations, employee profile, and organizational identity as identity provides meaning and security. Public organizations may identify with values that imply a more lenient identity, distancing themselves from "traditional" authoritative and bureaucratic identity. This kind of value statements can be considered symbols for constructing an organizational identity where (Wæraas 2010).

In public organizations, modern identity construction is a continuous process of narration in which the elements of narratives, "autobiographical acts", are constantly formulated and edited. Identity formulation is an interactive and collective process that can be managed as an organizational process. (Czarniawska-Joerges 1994). Thus, sustainability can act as a powerful idea that requires translation for formatting organizational identity and making sense of what sustainability means in public organizations.

5 Conclusions

This study examined the identity of PA in the context of sustainable policymaking. Our premise in this study was that the social processes of knowledge formation would ultimately define the essence of PA, representing its basic values, objectives, and tasks. This led us to investigate the organizational identity of PA. From our preliminary literature review, the key elements of knowledge formation in PA identity are:

- Public management reforms act as a catalyst for transformation and considering who we are as organization
- Identification process and identity work is a social process
- Organizational members sensemaking, activity of individuals in identity construction process
- Tradition is a resource for knowledge needed in identity work
- Communication and dialogue are rrerequisites for collectively interpreted identity construction, managers create forums for social interaction that promote cooperation and collaboration
- Context matters, institutional power play: instead of institutionalized identity, multiple and dynamic identities, hybridization.

Although sustainability was not discussed in any of the reviewed studies, the review provided many insights into the role of knowledge formation processes in identity work. First, studies focusing on public sector reforms (e.g. Brunsson & Sahlin-Andersson 2000; de Boer et al. 2007; Rondeaux 2006) and new public management in particular (Skålén, 2004; Palma et al. 2010) stress that a change in organization or strategy necessitates dialogue and collective sense-making of the transformed situation. It was highlighted that the identity of PA is socially constructed (e.g., Beech et al., 2008; Garcia & Hardy, 2007; de Boer et al., 2007; Zalmanovitch, 2014) and due to long-standing traditions of the bureaucracy in public organizations, more attention must be paid to the contextual determinants of change (external, inter-organizational, and individual factors, see Bankins and Waterhouse 2019) It is a task of management to promote collaboration, dialogue, and social interaction to construct knowledge for organizational identity (Mönkkönen & Puusa, 2015).

Second, the literature shows that multiple identities of PA may exist at the same time due to inconsistent values, and PA modernization efforts may spur identity hybridization (Rondeaux, 2006; Wæraas, 2010). Thus, the critical question for identity dynamics in public organizations is, who are we? This is an important issue when considering sustainability and its implications in public management. Management doctrines, such as NPM, have transformed public organizations' traditional universal values (Palma et al. 2010; Rondeaux, 2014). In the context of sustainability, public organizations may favor a softer organizational identity instead of their bureaucratic public sector identity (Wæraas, 2010). Thus, identity can be used as a strategic tool for promoting sustainability and organizational change or defending stability and continuity in organizations representing their future state (Fumasoli et al., 2015).

Finally, the literature brought out the issues of communication processes, brand, and image in public organizations that are used to demonstrate the specific mission and organizational identity of public organizations (Bankins & Waterhouse 2019). From the perspective of knowledge formation, the results demonstrate that, in each organization and decision-making situation, an understanding of the many purposes and values of PA is constructed. Therefore the role of individuals, narratives and values of organizational members cannot be ignored (Czarniawska-Joerges, 1994; Garcia & Hardy 2007; Wæraas, 2010). Simultaneously, in this knowledge formation process, the PA reinvents itself and

its identity is thus constantly evolving and reformed. As a result, in PA, there may be heterogeneous and conflicting organizational identities (Skålén, 2004).

For us, the review evidenced the importance of identity construction and identity work when public organizations confront such a wicked problem of sustainability According to Zalmanovitch (2014), in principle, the political pillar of identity determines what needs to be achieved whereas the managerial pillar decides how it is to be achieved. Sustainability is illustrative example of a strategic ambition or a policy goal. However, in concert, it represents the core values of PA: efficiency, effectiveness, and equity (Bartle & Leunenberger, 2014) and these key tenets are related to sustainability in various dimensions. Thus, PA is characterized by profound sustainability in its processes and practices (Trondal, 2021).

These observations encourage to continue studying more systematically 1) sustainability as an ambiguous policy goal and as a strategic objective of public sector organizations, and 2) collective sense-making and knowledge formation processes where understanding of societal and organizational values are constructed. Through the interaction and dialogue, an idea of the sustainable PA emerges, describing what it is like and what it should achieve. Although national governance systems vary in their historical-cultural contexts, the problem of knowledge formation to ensure sustainable PA and its implications for research or policymaking is indeed a global one.

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Evaluating Tourism Digital Ecosystems: A Knowledge Management Approach to Enhance Inner Areas

Diana Rolando

Politecnico di Torino
Viale Mattioli, 39, 10125, Turin; Italy

Alice Barreca

Politecnico di Torino
Viale Mattioli, 39, 10125, Turin; Italy

Eleonora Fiore

University of Parma
Parco Area delle Scienze, 181/A 43124, Parma; Italy

Andrea Di Salvo

Politecnico di Torino
Viale Mattioli, 39, 10125, Turin; Italy

Alexandra Stankulova*

Politecnico di Torino
Viale Mattioli, 39, 10125, Turin; Italy

** Corresponding author*

Abstract

In the Italian context, inner rural and mountain areas suffer from depopulation, an ageing population, a lack of services, and extreme seasonal tourism. In order to counteract this phenomenon, the Italian National Strategy for Inner Areas (SNAI) identifies sustainable tourism as a promising accelerator of local development, along with agricultural and food production, renewable energy supply chain, and handicraft.
In particular, in this paper the new 24 Italian mountain inner areas, selected by SNAI in the second programming cycle (2021-2027), were considered case studies representing challenging contexts for the development and implementation of innovative and sustainable cultural tourism ecosystems through digital services. More specifically, this work analyses a set of web platforms to identify the best practices in cultural and

experiential tourism, their lacks and their main features and thus support both public and private bodies in New Product Development (NPD) processes of digital tourist services aimed to enhance and promote specific territorial contexts.
A 5-phase knowledge management approach is proposed to evaluate different tourism digital ecosystems that foster the enjoyment of specific sites and territories by disseminating the knowledge on them, providing different tourist experiences and improving their tourist vocation. The evaluation procedure is an iterative circular process based on three steps aimed at analysing the digital ecosystems' objectives and the quality of a series of features characterising them.
Applying the proposed knowledge management approach to the preidentified case studies highlighted that most new Italian mountain inner areas still need an innovative and sustainable cultural tourism ecosystem. Still, two best practices among the selected platforms were identified, reaching very high scores both for their objectives and the quality levels of their features. Results showed that most of the considered web platforms present high-quality showcases of places, offered experiences, and relatively good communicative and informative aspects. On the contrary, the features with the lowest quality levels are the active profiling tools and the presence of written interviews, testimonies and videos with people who tell their stories.

Keywords – Knowledge management; Tourism experience platforms; Sustainable tourism; Cultural tourism; Inner areas.

Paper type – Academic Research Paper

1 Introduction

In the Italian context, inner rural and mountain areas suffer from depopulation, an ageing population, a lack of services, and extreme seasonal tourism. Nevertheless, precisely because they have never been intensely inhabited, these areas have undergone fewer changes over time. Therefore, they preserve an essential part of the national historical and cultural heritage, handing down historic buildings and the most ancient traditions, crafts, material culture, natural landscapes and customs.

The national strategy for inner areas (SNAI) identifies sustainable tourism as a promising accelerator of local development, along with agricultural and food production, renewable energy supply chain, and handicraft (Lucatelli, 2016). Most inner areas rely on tourism as a dominant driver to implement long-run and sustainable local development. In recent years some tourist trends have reversed, such as the increase in proximity and sustainable tourism against destinations

overexposed and undergo mass tourism, but more is needed to ensure these areas' subsistence or sustainable development (Romagosa, 2020; Salmela et al., 2021). In rural environments characterised by a rich endowment of historical hamlets, archaeological heritage, monuments, museums, UNESCO sites, and natural parks, the tourism offer is based on cultural heritage, environmental recreation, sports activities, food and wine enjoyment (Andreoli and Silvestri, 2017).

The reactivation and enhancement of inner areas currently represent key challenges both at national and local levels: different funding measures and policies have been addressed for tourism development, but these must be used in favour of the development of resilient, circular, and sustainable models of cultural tourism and to avoid well-known phenomena of territorial over-tourism (Dodds and Butler, 2019; Ivona et al., 2021). Otherwise, territorial networks and cultural events can act as a real engine of development for the cultural tourism ecosystem as well as the increasingly widespread use of digital technologies (Baggio, 2020).

In the last 15 years, a profound debate has concerned the hypothesis of territorial development driven by tourism, theoretically and empirically. On the one hand, the typical conditions for economic growth, such as political institutions enforcing property rights, prices stability, and public investments in infrastructure and education, can favour any rental activity and, among others, tourism since the institutional solidity and local communities with a high level of quality of life act as the strongest attractor to foreigners and tourists (Payne and Mervar, 2010).

On the other hand, Information and Communication Technologies recently radically changed the global business context, generating innovative tools, methodologies and functions to be applied also for the development of tourism digital ecosystems. These are now facilitating and fostering strategic management, marketing (also territorial), sales and customer services to support companies and municipalities in developing competitive new digital services (Nikoli and Lazakidou, 2019).

Digital services are today considered essential, especially for promotional activities (Tichaawa et al., 2017). ICTs for tourism can be considered as an ecosystem of connected tools that can mutually foster communication (Serafeim, 2020) and interaction, also reducing the cultural, geographical, political and communication boundaries. Furthermore, such tools can also analyse data about, for example, competitive destinations and guest complaints, and even better

forecast tourism demand or communicate statistical information. In detail, applications accessible through social web pages have been studied to gain insight (Milano et al., 2011) into how travellers use them to: plan their journeys (Burgess et al., 2009; Tham et al., 2013; Xiang and Gretzel, 2010); to choose destinations between many possibilities (Di Pietro et al., 2012; Huete-Alcocer et al., 2019; Shafiee et al., 2016) that can be considered the combination of beliefs and impressions developed over time based on information gathered and processed from different sources (Phillips et al., 2017); to exchange users' information (Parra-López and Martínez-González, 2018; Tatsiopoulos and Boutsinas, 2010); to look for specific territorial food (Vila et al., 2021) and to build relationships by creating, sharing, and consuming social media content (Kang and Schuett, 2013; Munar et al., 2013).

In this line, the tourism supply is based on online platforms for territorial communication and marketing, thus enabling municipalities, local bodies and small villages to communicate and offer their touristic services worldwide. These platforms' effectiveness, efficiency and updating allow for the excellent or lousy promotion of a peripheral territory locally and globally. Grounded in the knowledge-based view of the New Product Development (NPD) intended as a cognitive process characterised by the use, development and management of knowledge assets, this paper, employing a multi-case studies analysis, stresses the importance of considering knowledge assets as value drivers that can support NPD process performance improvements.

In this framework, this paper proposes a 5-phase knowledge management approach including an iterative evaluation process to assess tourism digital ecosystems. In particular, a set of web platforms related to the new 24 Italian mountain inner areas, selected by SNAI in the second programming cycle (2021-2027), were considered case studies representing challenging contexts for the development and implementation of innovative and sustainable digital services. The evaluation of these web platforms, in terms of efficiency and efficacy, is aimed to identify best practices in cultural and experiential tourism, their lacks and their main features and thus support both public and private bodies in New Product Development (NPD) processes of digital tourist services aimed to enhance and promote specific territorial contexts.

The proposed knowledge management approach can highlight a useful overview on mountain inner areas' web platforms by employing positioning maps based on different parameters, such as their objectives, the quality of a series of

features and the offered experiences. The choice of parameters and their correlations are made by following a systemic approach capable of bringing out virtuous relations to be applied in specific territorial contexts (Bistagnino, 2009; Rolando et al., 2022a, 2022b). Some key parameters are related to the determination of the most widespread types of experiences proposed to understand the most common goals of digital tourism ecosystems and their positive impacts on the communities in improving the quality of life of citizens and tourists (Cutler and Carmichael, 2010; Obenour et al., 2006; Ryan, 2010). Furthermore, various web platform tools are analysed by drawing a map of the most efficient tag networks and the most effective ways of feeding a local and a global web community. This analysis evaluates how knowledge management in tourism platforms should promote a slow and sustainable perspective and the empowerment of tourism destinations. The more sustainable tourism strategies and practices are finally interpreted by considering the challenge of achieving a tourism-driven development in inner areas to build innovative, resilient and smart tourism digital ecosystems.

The paper includes a brief description of the proposed five-step methodological approach in Section 2, while introduces the web platform data sample related to the selected case studies in Section 3. The results of the web platform evaluation process are illustrated in Section 5, and some concluding remarks are proposed in the last section.

2 Methodological approach

This paper presents a methodological approach to evaluate tourism digital ecosystems that provide different digital tourist services and promote the enjoyment of inner areas.

The methodological approach is based on five sequential phases (Fig.1). It includes an iterative evaluation process that can support experts in analysing web platforms' objectives and purposes, the quality of a series of features, including service and some technical aspects.

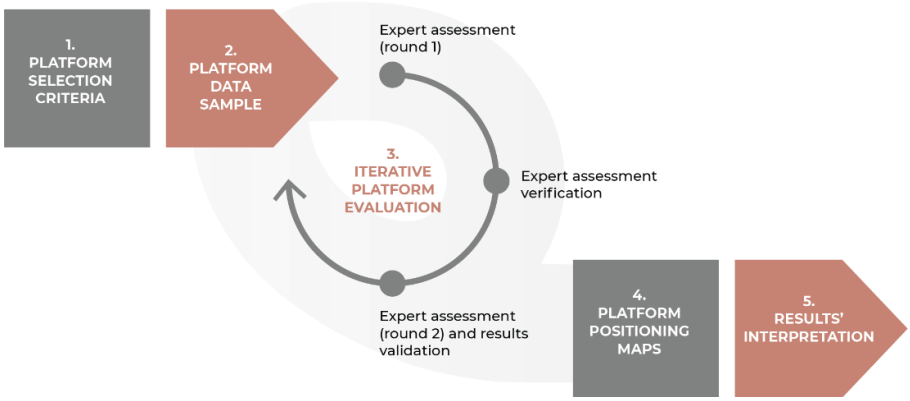

Figure 1. Phases of the methodological approach (Source: Authors' elaboration)

2.1 Platform selection criteria

The first phase defines a preliminary set of criteria to select the web platforms coherently with the research objectives. In this phase, it is fundamental to choose the territorial scale of the analysis, which can be regional, national, or broader and might select a specific context (e.g., cities, inner territories, mountain areas or coastal towns). Furthermore, it is crucial to set the necessary criteria to analyse two main objectives of platforms closely related to the research questions (giving visibility to the territory and attracting tourists by improving the tourist vocation of the territory) and to define a series of variables that highlight their key elements (e.g., the presence of a showcase, calendar or stories).

2.2 Platform data sample

In the second phase, the web platforms to be analysed are identified and selected based on previously defined criteria and variables. Therefore, data must be collected, structured, and organized in a sample that can be progressively completed and further detailed by including new cases or variables.

2.3 Iterative platform evaluation

The third phase evaluates the selected platforms, representing a crucial step of the proposed methodological approach. The evaluation procedure is an iterative circular process in which the platforms can be evaluated and compared on different aspects, such as their primary objectives and the quality of a series of

features (services and technical aspects). Table 1 describes the two above-mentioned main objectives, five more specific objectives, and nine features related to services and technical aspects.

Table 1: Objectives and services and technical aspects

Objective	**Description**	**Evaluation scale**
Visibility	To make the territory more visible and well-known by publicising and raising awareness and attention on the territory.	0=absent; 1=marginal; 2=principal
Attractiveness	To improve the tourist vocation of the territory by promoting the regeneration of tourist areas/territories and boosting the tourism sector (attracting people).	0=absent; 1=marginal; 2=principal
Services	To offer valuable services to support travel or experiences organization in the area.	0=absent; 1=marginal; 2=principal
Community	To create a community of people interested in visiting the territory and sharing experiences through blogs and social media groups, through which users can interact and create different networks.	0=absent; 1=marginal; 2=principal
Built heritage	To exploit and enhance the built heritage of the territory by improving its knowledge and fostering its enjoyment.	0=absent; 1=marginal; 2=principal
Natural environment	To exploit and enhance the natural environment of the territory by improving its knowledge, fostering its enjoyment and promoting its sustainable use.	0=absent; 1=marginal; 2=principal
Social innovation	To foster and support social innovation through the proposed activities in terms of economic and social development in a specific community.	0=absent; 1=marginal; 2=principal
Features	**Description**	**Evaluation scale**
Showcase	Presence of a comprehensive showcase of places and experiences, with clear evidence of location, period and typology of them.	0=absent;1=insufficient; 2=sufficient; 3=good; 4=excellent
Map	Presence of a helpful geographical map to identify places and experiences and to support the travel organization.	0=absent;1=insufficient; 2=sufficient; 3=good; 4=excellent
Calendar	Presence of a helpful calendar to identify when specific events and experiences are scheduled and can be enjoyed throughout the year.	0=absent;1=insufficient; 2=sufficient; 3=good; 4=excellent
Tailoring	Presence of a series of sightseeing itineraries and experiences designed and planned for specific target users or themes. Possibility to create tailored travel	0=absent;1=insufficient; 2=sufficient; 3=good; 4=excellent

	directly by the users: i.e., view favourite places on the map, choose in which order to visit them, plan the expected dates of the trip, save valid addresses for sleeping and eating, print and share one's travels with friends.	
Active profiling	Active or transparent profiling allows users to be aware of the personal information collected by the web platform, control their choice data and obtain an offer of a personalised product. Possibility to create a personal account.	0=absent;1=insufficient; 2=sufficient; 3=good; 4=excellent
Networking	Presence of the inscription to the newsletter, presence of a dedicated section for b2b and new investors. Presence of territorial/thematic cards as a passport to visit attractions.	0=absent;1=insufficient; 2=sufficient; 3=good; 4=excellent
Stories	Presence of stories (written interviews, videos, testimonies) which enhance local traditions, people and specific tales related to territory.	0=absent;1=insufficient; 2=sufficient; 3=good; 4=excellent
Usability	Presence of an optimal layout/grid of the site, a hierarchy of information presented, number of clicks to reach the information sought which make navigation quick and easy, and the main information is found in a short time	0=absent;1=insufficient; 2=sufficient; 3=good; 4=excellent
Clarity	Presence of excellent correspondence between the communicative and informative aspects; a complete and exhaustive combination of texts, images and videos inform the user in the best possible way; the font chosen is adequate, and the texts are easily legible.	0=absent;1=insufficient; 2=sufficient; 3=good; 4=excellent

(Source: Authors' elaboration)

After the data collection, the consistency of the web platform data sample is verified in relation to the main objectives of the research ("visibility" and "attractiveness" in Table 1). Based on three phases, the evaluation of web platforms is led by a panel of experts who, during the first round, independently analyse and evaluate each web platform and fill the scores in a structured evaluation form. Then, the experts quantitatively check the scores expressed to correct any errors and avoid the subjectivity of the evaluation by defining specific thresholds for the standard deviation of the scores expressed for each characteristic. Finally, during the second round, the experts work together to correct the errors that emerged after the first round and the evaluation verification procedure.

2.4 Platform positioning maps

After the evaluation results validation, it is possible to calculate the mean value of each objective/service to develop matrixes related to different pairs of variables. Furthermore, the quality of the evaluated platforms can be analysed by employing positioning maps to identify both those services/technical aspects that are generally present and adequate and those that are often missing or unsuitable.

2.5 Results interpretation

In the last phase of the proposed methodological approach, results were read and interpreted in relation to a broader research context. In this phase, it is interesting to outline the most and the lowest scoring objectives and find the cluster of platforms that reach the higher overall score, identifying them as best practices for one or more variables. Finally, some specific topics can be focused on to deepen the analysis according to the aim of the research.

3 Case studies

Tourism development is one of the possible measures to counteract the degradation problem characterising the rural territories and reactivate them. Thus, this paper considers the new inner areas selected in the second programming cycle (2021-2027) by the SNAI, and more specifically, the new mountain inner areas as case studies. In this second programming cycle (2021-2027), 43 areas were selected (Fig.2), from which 18 are located in the North of Italy, 10 in Central Italy and 15 in the South of Italy. It is also interesting that 24 can be considered mountain territories (in this case, a mountain area is considered an inner area with Average Altitude higher than 600 m.a.s.l.). Of these new 24 mountain inner areas, 16 are in the North of Italy, 7 in the South of Italy and only 1 in Central Italy.

This work investigates platforms that cover and promote a territory that corresponds as much as possible to a territory included within the boundaries of a certain inner area to identify the best practices, the lacks and the main features that characterise the state of the territorial promotion and branding of the new mountain inner areas in Italy. On this regard it is worth mentioning that the boundaries of the Italian inner areas are not defined for tourist purposes since the

SNAI criteria include also other socio-economic aspects (such as the presence of services related to education, health and transports).

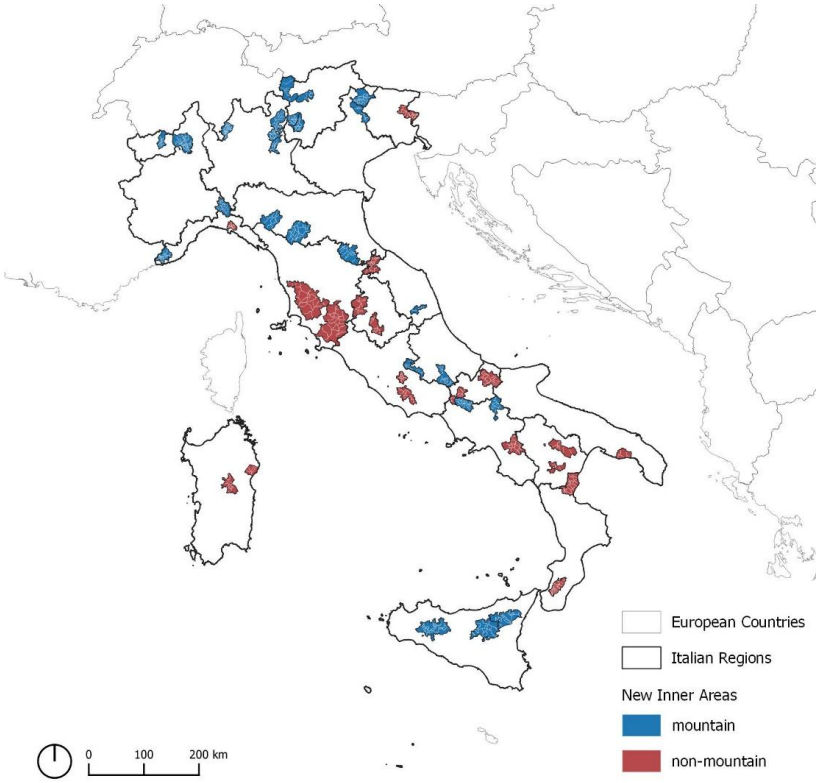

Figure 2. A map representing the 43 new inner areas, selected in the programming cycle 2021-2027 of SNAI, divided into mountain and non-mountain inner areas (Source: Authors' elaboration)

4 Results

The following paragraphs will present the results of each step of the applied methodological approach.

4.1 Platform selection criteria

To critically select the platforms that most accurately represent the research objectives, a list of 8 essential criteria was made (Table 2), which each web

platform must comply with to be included in the data sample and further analysed.

Table 2: List of the selection criteria identified

N	Selection criteria	Type of criteria
1	Platforms representing territories that have been identified as new inner areas according to the Italian National Strategy for Inner Areas (SNAI) in the second programming cycle 2021-2027, with an Average Altitude higher than 600m	Geographical
2	High correspondence between the area represented by the platform and the area included in a specific inner area	Geographical
3	Extension of the geographical area, promoted by the platform, on an administrative level not higher than a regional	Geographical
4	Exclusion of the simple informative websites - selection of only complex platforms offering tags, descriptions, filters etc.	Typological
5	Exclusion of apps	Typological
6	Fulfilment of the two first and main objectives identifies (Table 1) which are: 1) making the territory more visible and well-known 2) boosting the tourism sector (attracting people)	Content
7	Presence of experiences - related not only to accommodation and gastronomic experiences - but also to special itineraries, visits, laboratories etc.	Content
8	Presence of the possibility to purchase an experience directly from the platform to have direct contact with the specific operator providing it	Content

(Source: Authors' elaboration)

4.2 Platform data sample

After the initial identification of the new inner areas, selected in the second programming cycle (2021-2027) by SNAI, and all their corresponding municipalities, the Average Altitude of each inner area was calculated and was proceeded with the research of the platforms aimed to promote the newly selected mountain inner areas (the ones with an Average Altitude higher than 600 m.a.s.l.). It is interesting that of all 24 mountain inner areas, 10 of them do not present any web platform for territorial promotion. On the contrary, for the remaining 14 mountain inner areas, 19 platforms were encountered – a phenomenon that could be explained by mentioning that the boundaries of an inner area do not always correspond to the boundaries of a specific geographical area. Instead, the inner area often includes more than one geographical area.

After the application of all the selection criteria, from these 19 platforms, only 9 of them were selected as suitable (Table 3). It is interesting that all 9 of them are

promoting inner areas located in the North of Italy and that 2 of them are covering a territory of 2 inner areas each.

Table 3: The list of the 9 selected platforms

id	Region	Inner area	Average Altitude (m.a.s.l.) *	Platform	Domain created Domain updated Age	Notes for the represented territory
P01	PA Bolzano	Alta Val Venosta	2245,24	SüdTirol	2001/08/01 2022/09/15 21 Years 7 Months	Big platform that covers 2 inner areas (Val Venosta and Val d'Ultimo-Alta Val di Non-Tesimo-Lana) and also some more territories outside their boundaries.
		Val d'Ultimo-Alta Val di Non-Tesimo-Lana	1511,75			
P02	PA Trento	Valle Rendena	1933,14	Madonna di Campiglio	2010/07/05 2022/07/21 12 Years 8 Months	Platform that covers 2 inner areas (Valle Rendena and Giudicarie Centrali ed Esteriori) and also some more territories outside their boundaries.
		Giudicarie Centrali ed Esteriori	1046,84			
P03	Veneto	Cadore	1572,88	Cadore Dolomiti	1997/11/27 2023/02/22 25 Years 4 Months	The platform covers an area smaller than the territory of the inner area, but still 8 of its 13 municipalities are represented.
P04	Lombardia	Valcamonica	1517,82	Valle Camonica - La Valle dei Segni	2012/06/04 2023/01/05 10 Years 9 Months	The territory represented by the platform corresponds to the territory of the inner area.
P05	PA Bolzano	Val d'Ultimo-Alta Val di Non-Tesimo-Lana	1511,75	Val di Non	2007/12/11 2023/02/07 15 Years 3 Months	The platform represents only one part of the inner area – Val di Non.
P06	Piemonte	Valsesia	1358,46	In Valsesia	2014/02/27 2023/03/15 9 Years 1 Month	The territory represented is smaller than the territory of the inner area. It lacks the geographical area of Valsessera.
P07	Piemonte	Valsesia	1358,46	Valsesia & Vercelli	2022/11/09 2022/11/09 0 Years 4 Months	The platform lacks the geographical area of Valsessera, a part of the territory of the inner area, while it also covers some areas outside its

						boundary.
P08	Emilia-Romagna	Appennino Modenese	804,26	in Appennino Modenese	2019/07/05 2022/06/28 3 Years 8 Months	The platform covers an area smaller than the territory of the inner area; nevertheless, 11 of its 18 municipalities are represented.
P09	Emilia-Romagna	Appennino Parma Est	753,71	Appennino Emilia	2021/07/26 2022/08/11 1 Years 8 Months	The platform covers an area much bigger than the territory of the inner area itself, but its entire area is included.

(Source: Authors' elaboration)
*Weighted average calculated based on the average altitude of each municipality included in the specific inner area and its surface.

4.3 Iterative platform evaluation

The platform evaluation is an iterative process based on three steps, in this case, performed by a group of 5 experts. After the identification of the 9 platforms (Table 3), the first step was the verification of their coherence with the 2 main objectives ("visibility" and "tourists" presented in Table 1) by all 5 experts. Afterwards, each expert evaluated each platform, performing individually, according to the pre-identified objectives and features (Table 1). In the last step – verifying the scores, some but many incoherencies among the evaluations of the different experts were identified, mainly caused by the platforms' interface or menu unclarity.

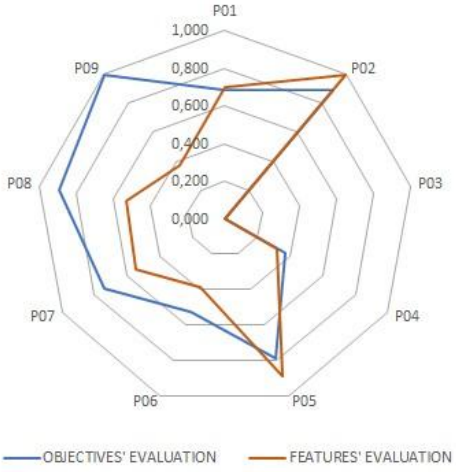

Figure 3. A spider graph representing the standardised evaluations of the expert group, where the numerations P01-P09 are the platforms' ids (Source: Authors' elaboration)

As a first result, it can be observed in Figure 3 that platforms P02, P05, P08 and P09 have obtained the best scores for the objectives' evaluation, while the best web platforms for the features' evaluation are only P02 and P05. More specifically, P02 and P05 platforms (Madonna di Campiglio and Val di Non) have obtained the best evaluation of their objectives and reached the highest quality levels of their proposed features. The P01 platform (Südtirol) can also be counted as among the best, even if it has some shortcomings in both the objectives and the characteristics. Otherwise, P08 and P09 (in Appennino Modenese, Appennino Emilia) show a big gap between their pre-stabilised objectives and the actual realisation of the platforms. This gap for P06 and P07 (In Valsesia, Valsesia & Vercelli) is a bit smaller. The lowest evaluation for both their objectives and features is observed for P03 and P04 (Cadore Dolomiti, Valle Camonica - La valle dei Segni). From these first observations, two platforms appear as best practices for different reasons - Madonna di Campiglio (P02) and Val di Non (P05). However other platforms present some specific optimal tool or feature that is worth to be explored.

4.4 Platform positioning maps

In this step, the mean values obtained from the experts' group evaluations were analysed, and pairs of variables were chosen to construct two positioning maps. It was decided to create one map taking into consideration the two variables (relative to the platforms' features) with the highest scores, which in this case are the Showcase and Clarity (Fig.4a) and one map taking in consideration the two variables with the lowest score, which in this data sample showed to be the Active profiling and Stories (Fig.4b). This would allow us to analyse which are the best practices among the platforms both for the features that are widely used and mainly well-developed but also for the ones that are more often neglected.

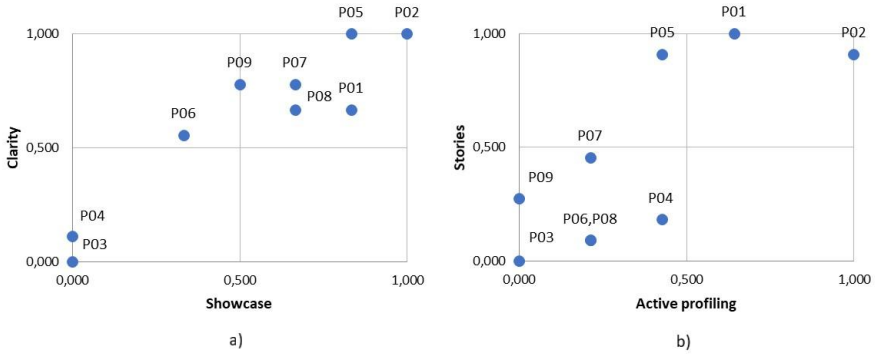

Figure 4. The positioning maps constructed: a) taking into consideration the pair of variables with the highest score in all the platforms (Showcase and Clarity), b) taking into consideration the pair of variables with the lowest score in all the web platforms (Active profiling and Stories) (Source: Authors' elaboration)

It can be clearly observed that regarding both the Clarity and the Showcase (Fig. 4a), the best example is P02 (Madonna di Campiglio) that have obtained the highest evaluation for both variables. Another best practice is P05 (Val di Non), which has also obtained the highest score for Clarity and is among the highest scores for the Showcase. Other good examples of Showcase and Clarity features are P01, P07 and P08 (Südtirol, in Appennino Modenese, Appennino Emilia). It can be noticed that the lowest scores regarding these two variables are those of P03 and P04 (Cadore Dolomiti, Valle Camonica - La valle dei Segni)

Regarding the features of Active profiling and Stories (Fig. 4b), the platform that could be considered as best practice is again P02 (Madonna di Campiglio) and also P01 (Südtirol). It is interesting the position that P05 (Val di Non) takes in this positioning map, showing some lacks in the Active profiling but achieving a very high score for the Stories feature. All the other platforms have obtained scores lower than the average for both the Active profiling and the Stories.

All these considerations also seem coherent with the first observations made in the previous step – showing as best practices platforms P02 and P05 and as underdeveloped ones platforms P03 and P04.

4.5 Results interpretation

As mentioned, some best practices can be highlighted and insightfully exploited in designing new web platforms for inner areas. When assessing the quality of the offer of services, we carefully looked for authentic experiences in

which the territory would emerge as peculiar, and the local people could teach or tell their story. This is the case of P02 (Madonna di Campiglio), which showcases local experiences and/or made with local people (Fig.5a). P05 (Val di Non) web platform provides another excellent example, since this mountain area of Trentino alto Adige, for instance, is particularly renowned for apples and offers a series of themed experiences (Fig.5b).

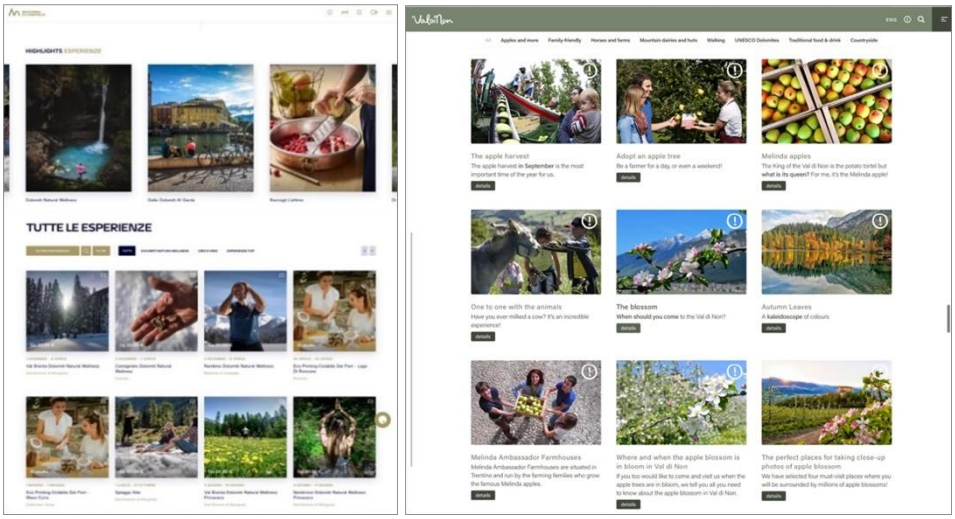

Figure 5. a) Madonna di Campiglio's Showcase of local experiences. b) Val di Non's apple Showcase of experiences. (Source a) Madonna di Campiglio Azienda per il Turismo S.p.A. b) Azienda per il Turismo Val Di Non Soc. Coop)

Therefore, the narrative aspect of the item concerning local stories is strictly correlated. For this aspect, we can state that P01 (Südtirol) offers a more comprehensive section of "stories". Figures 6a and 6b show some differences between the Italian and English versions of the web platform in terms of contents and layouts. The Italian version is more populated with two dedicated sections; "People in brief" and "Stories to be experienced". This means that the platform presents a quite different narrative offer for different targets, moving slightly towards what is probably the most sought-after by Italian and foreign tourists.

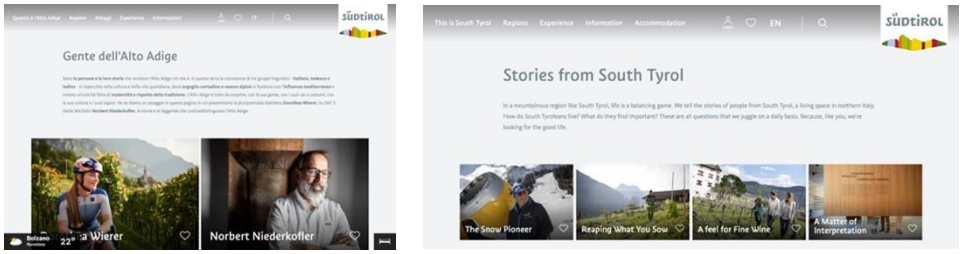

Figure 6. a) Italian version "People from Alto Adige". b). English section "Stories from South Tyrol. (Source: IDM Südtirol)

Finally, Figure 7 provides two examples of a page dedicated to personalities who have distinguished themselves in South Tyrol for invention, or sporting performance, or entrepreneurial model, or culture or other.

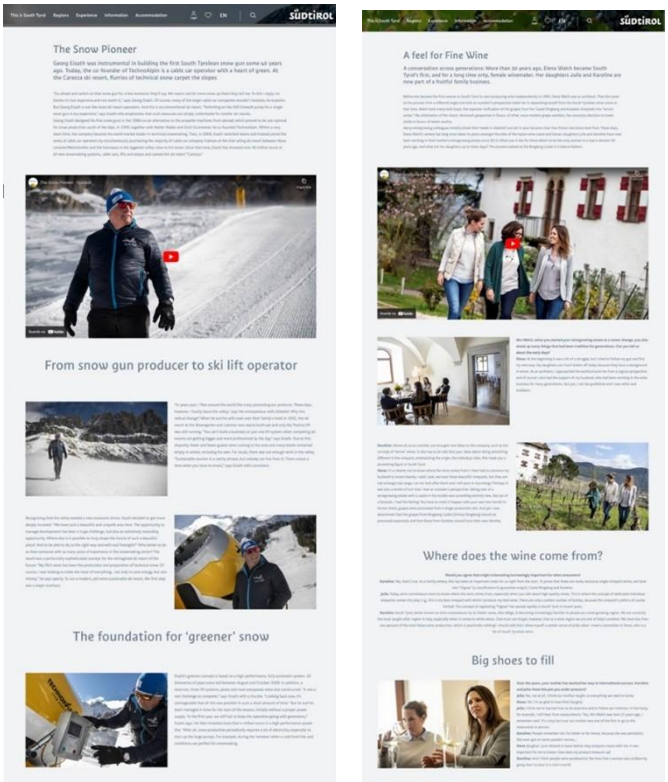

Figure 7. a) Example of a well-developed "Stories" section: "The sow pioneer, George Eisath". Figure b) Example of a well-developed "Stories" section: A feel for fine wine, Elena Walch". (Source: IDM Südtirol https://www.suedtirol.info/storiesfromsouthtyrol)

Far from being exhaustive, the result section aims to show the potential of platforms' benchmarking, evaluation and comparison. Indeed, by analysing best practices or virtuous examples, it could be easier to support stakeholders in developing detailed guidelines for implementing new web platforms dedicated to enhancing inner areas by leveraging some communicative and operational aspects. Moreover, the results focused on pairs of items such as *Showcase/Clarity* and *Active profiling/Stories* items with the positioning map method; and *Showcase* and *Stories* with the case study analysis. These items have been identified as the worthiest qualitative aspects to be implemented when designing a new platform for inner mountain areas. Another important aspect often mistreated is the *Networking* relevance of the platform analysed. For example, some web platforms created newsletters, tourist cards or "territorial passports", which we interpret as evidence of the effort to connect and make the various territorial stakeholders dialogue. However, besides P09 (Appennino Emilia) – which we believed had among its goals to support social innovation – a dedicated section for b2b and new investors is often missing in the cases analysed.

5 Conclusions

In recent years, the economic and management literature has largely stressed the importance of knowledge assets for company competitiveness. Grounded in the knowledge-based view of the firm, which interprets the New Product Development (NPD) as a cognitive process characterised by the use, development and management of knowledge assets, this paper, employing a multi-case studies analysis, stresses the importance of considering knowledge assets as value drivers that can support NPD process performance improvements.

In particular, the new 24 Italian mountain inner areas, selected in the second programming cycle (2021-2027) by SNAI, were considered challenging contexts for developing digital tourism services. Implementing innovative and sustainable cultural tourism ecosystems (web platforms, apps and websites) aimed at disseminating knowledge on specific sites and territories and fostering their enjoyment represents a key objective for both public and private bodies to enhance inner mountain areas and improve their tourist vocation.

A 5-phase knowledge management approach supported the analysis and evaluation of a set of web platforms related to inner mountain areas, assumed as case studies and best practices in cultural and experiential tourism. Based on an

iterative circular process, the evaluation procedure guided 5 experts in assessing the main objectives of the selected case studies. The results highlighted two best practices (the web platforms of Madonna di Campiglio and Val di Non) that reached very high scores both their objectives and the quality levels of their features. The 5 experts evaluated the quality level of the platform features defined in the methodological approach (Showcase; Map; Calendar; Tailoring; Active profiling; Networking; Stories; Usability; Clarity) for each selected case study and built some positioning maps based on couples of the abovementioned features. Results showed that most of the considered web platforms present high-quality Showcases of places and offered experiences, as well as rather good communicative and informative aspects that reflect the Clarity of the platform's contents. On the contrary, Active profiling is often absent or has a low-quality level, together with the Stories section (written interviews, videos, testimonies) aimed to enhance local traditions, people and specific tales related to territory,

Furthermore, the evaluation results highlighted some interesting best practices or virtuous examples for specific features and services that could be assumed as a sort of guidelines for designing new web platforms dedicated to enhance inner areas by leveraging some communicative and operational aspects. On the contrary, some results also showed some cases that could be useful to avoid the most common errors.

The application of the proposed knowledge management approach for the analysis of the current web platforms of the new Italian mountain inner areas highlighted that most of them do not have an innovative and sustainable cultural tourism ecosystem, which could be developed by public or private bodies to empower those tourism destinations and to promote the knowledge of them worldwide. By analysing the specific features of the existing platforms, there is scope for improvement to foster inner areas' potentialities.

Nevertheless, it is worth mentioning that this research presents some limitations related to the small data sample, limited to 9 case studies, that could be extended by including the web platforms related to all 43 new inner areas (not only the mountain ones) in order to outline a more comprehensive overview on the current presence of adequate cultural tourism ecosystems in these fragile territories. Moreover, the quality level of other features could be deepened by building other positioning maps highlighting different issues that deserve improvement during the development of digital tourism services. Finally, the

platform evaluation procedure could be repeated by involving other experts and by comparing and thus validating the final results.

Identifying an inner area, which could be assumed as an actual case study for developing a web platform, represents an opportunity to use the identified main objectives and features as guidelines for developing innovative, resilient and sustainable digital tourism ecosystems.

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Engaging our Digital Technology Actors in Learning HealthCare Ecosystems for Sustainability and Equity

Nabil Georges Badr*

Higher Institute for Public health
Saint Joseph University of Beirut
Beirut, Lebanon

Luca Carrubbo

Università degli Studi di Salerno
Dipartimento DISA-MIS di Scienze Aziendali, Management & Innovation Systems

Giovanni Baldi

Università degli Studi di Salerno
Dipartimento DISA-MIS di Scienze Aziendali, Management & Innovation Systems

** Corresponding author*

Abstract

Involved actors in healthcare processes have been reformulated: with systems servitization and patient engagement with awareness of their care pathway can be clarified through the Actor-for-Actor (A4A) approach. Referring precisely to this cyclically phased model, we focused on the structural prerequisites of engagement and relationships among actors and examined the determinants of the system and their commitment to the value of equitable care delivery: a system in which there are no unfair and avoidable or remediable differences between socially, economically, demographically, or geographically defined population groups. Looking through the A4A lens and using a dynamic systems approach, we find that motivational drivers for our digital technology actors' commitment to value-based care are rooted in meaningful data resource integration for meaningful interactions and timely, accurate decision-making. By analysing use cases of digital technology in support of the healthcare ecosystem such as artificial intelligence and robotics for telemedicine and remote patient monitoring, we witness the potential of equitable care to the population in compliance with the quintuple aim for health system performance.

Keywords Health Equity, Artificial Intelligence, Telehealth, Learning Healthcare Ecosystem, Sustainability

Paper type – Practical Paper

1 Introduction

A learning health system is an essential foundation for equity and sustainability (McGuckin et al., 2022; Bazemore et al., 2022; Gummeson et al., 2019). Learning care practice's main approach is to use predictive modelling in conjunction with evidence-based best practices to achieve and maintain population level health gains (Srinivasan et al., 2020). A learning pharmacy practice for example, continually generates data powered discoveries as a by-product of pharmacists' patient care process interactions, information from patients on drug interactions, to supplement clinical and research findings (Lester et al., 2020), transforming information for the service of equitable care. Every encounter generates data, which is then merged with existing data and analysed by teams of pharmacists and data scientists. The new knowledge gained is subsequently applied to all future contacts in the form of forecasts and actionable suggestions. The cycle of knowledge transformation creates a type of Information Common Goods that aid in the democratization of information and its availability for long-term societal growth (Badr et al., 2020).

Referring precisely to a cyclically phased model, we focus on the structural prerequisites of engagement and relationships among actors and examined the determinants of the system and their commitment to the value of equitable care delivery: a system in which there are no unfair and avoidable or remediable differences between socially, economically, demographically, or geographically defined population groups.

In this paper, we survey the contribution of digital health actors and the motivational drivers for value based care rooted in affording care equitably to the population in fulfilment of the quintuple aim. We reformulate involved actors in healthcare processes through systems servitization, technology innovation and patient engagement with awareness of their care pathway can be clarified through the Actor-for-Actor (A4A) approach (Barile et al. 2016; Polese et al., 2017). Looking through the A4A lens and using a dynamic systems approach, we find that motivational drivers for our digital technology actors' commitment to

value-based care are rooted in meaningful data resource integration for meaningful interactions and timely, accurate decision-making. By analysing use cases of digital technology in support of the healthcare ecosystem such as artificial intelligence and robotics for telemedicine and remote patient monitoring, we witness the potential of equitable care to the population in compliance with the quintuple aim for health system performance.

2 Methodology

In the perspective of value-based healthcare, the roles of the actors involved in healthcare processes are being redefined. On one hand, services extend beyond the walls of medical facilities; on the other hand, patients' involvement and awareness of their care pathway can be clarified through the Actor-for-Actor (A4A) approach (Polese et al., 2017). A4A frames the interactions between actors in an ecosystem to understand the value chain. By referring to the cyclical model of A4A steps, we focus on the structural pre-conditions of actor's engagement, and relationships, then reviewed the system determinants and their engagement in the value of providing equitable care. Looking through the A4A lens, we can find those motivational drivers for engaging our digital technology actors using a system dynamics approach that includes proactivity, the convergence of ideas and values, shared intentionality, equality, cognitive alignment, integration of resources, emergence, and viability (Polese et al., 2017). Each actors becomes interested and 'engaged' in a given role within the care ecosystem (A4A - Actors' engagement). Therefore, actors in an equitable healthcare ecosystem become interested in the connection between people's access to and understanding of health services and their health. After the first 'connection' of important actors has led to the start of the engagement, it is feasible to observe ongoing interactions that are triggered by the alignment of aims and common purpose among all parties involved (A4A - Actors' relationships). When the context in which this engagement takes place is populated by multiple actors whose behavior can directly or indirectly influence (on the other hand, reciprocally) the engagement, this awareness becomes part of recognizing various spheres of equity that can influence the success of the engagement (A4A - Subjective awareness). Recognizing factors and constraints that influence each agent should lead to the development of shared purpose (A4A - Shared intentionality). When all parties involved cooperate, with shared intentionality, because they believe

that working together will result in mutual satisfaction, real or perceived, they can work toward common goals and bridge gaps (A4A - Finality Alignment). All aspects of the healthcare system, from practitioner, to patient, caregiver to information systems, law and payment systems to delivery design, assessment, patient engagement/democratization, training, and research, should be linked to improving the value and equity of healthcare during the next stage of transformation (Fiscella, 2019). In A4A, the latter is referred to as resource integration. (A4A – Resource Integration). Resource integration is critical for a system of actors to emergence in action. Once a care decision has been made, resources must be integrated to provide ongoing and accessible treatment to all groups of patients, regardless of location, social issues, or other limitations that can limit patient movement to the point of care.

3 Getting to Know our Digital Health Actors

Digital health, digital medicine, and digital therapies offer opportunities for life sciences and stakeholders to develop more personalized experiences and new ways of targeting patients as well as solutions to augment decision-making: Targeting medication non-adherence behavior (van Mierlo et al., 20150, in cases for hospitalization at home (Polese et al., 2018), and traceability (Dragoicea et al., 2021).

We review examples of digital health solutions in the literature, connected to equity in a learning healthcare ecosystem and identify such actors as Telehealth (TH), Artificial Intelligence (AI), cloud repositories, interactive portals with natural language processing (NLP). Additionally, solutions such as remote patient monitoring (RPM) that integrate devices and mobile APPs, robots and chatbots to avail equitable care at the reach of the population at large (Table 1).

Table 1: Getting to know our digital health actors - Technology in Focus with reference use cases

Telehealth (TH)	At Home Care (Allard, 2020); Pediatrics (Curfman et al., 2021; Cahan et al., 2020); Specialty care at a distance (Liddy et al., 2019); Midwifery & Telenursing (Sinclair, 2010; Silverio et al., 2021)
Artificial Intelligence (AI)	Cancer education (Wiljer, D., 2020); modelling work processes (Matheny et al., 2020); Models for improving bedside care (Smith et al., 2021); Centralized Electronic Platforms / AI-driven patient and caregiver engagement and connection platforms (van den Bemt et al., 2019)
Interactive	AI-based patient centricity and Tailored care (Kudumala et al., 2021) with Natural

Portals	Language Processing, for example.
Remote Patient Monitoring	Remote Patient Monitoring enable equity in access to Care at home (Baig & Gholamhosseini, 2013)
Devices and Mobile APPs	biosensors or wearable devices (Townsend et al., 2011); Vitals and adherence (Mohammed et al., 2019)
Robots	Robots shift the nursing function's unsettled resource-demand balance (Dankar & Badr, 2022).
Cloud Repositories	data aggregation and analytics (Celesti et al., 2019; Lai et al., 2020; Jadczyk et al., 2021; Laranjo et al., 2018; Jovanović, 2020; Kurup & Shetty, 2022)
Chatbots	Simulates human conversation (either written or spoken), allowing humans to interact with digital devices as if they were communicating with a real person (Nadarzynski et al., 2019; Softić et al., 2021). Intelligent triage assistant in COVID-19 "INAIL" (Duangdee & Lalitrojwong, 2021)

3.1 Telemedicine and Telehealth (TH)

We start our review with Telemedicine as one of the most innovative and interesting applications in connected value-based healthcare and a viable alternative to in-person care (Mohtar & Badr, 2022). Telemedicine and the broader domain of telehealth make high-quality services available in previously inaccessible locations leading to equity in patient engagement and facilitating citizens' access to health information and services (electronic health records, electronic medical records, clinical document repositories, departmental systems, digital services to the citizen, etc.).

3.2 Artificial Intelligence (AI) and Interactive Portals with NLP

Artificial Intelligence (AI) in healthcare is the theory and practice of health systems that can carry out tasks that would typically need human intelligence, such as speech recognition, visual perception, decision-making, and language processing. Models for improving bedside care continue to outpace adoption for quality care and equity (Smith et al., 2021). Decision-making and analytics provided through Artificial Intelligence, contribute to the realization of a learning health care system through modelling work processes, culture, equity, patient–provider relationships (Matheny et al., 2020). AI mitigates health inequities by improving partnerships between Physicians and technologists (Lin, 2022), and empowering multidisciplinary developmental science teams with expertise in cognitive development, medicine, psychology, computer science, and medical informatics (Israni et al., 2020). AI-driven patient and caregiver engagement and connection platforms (HCPs) can provide patients, partners with immediate access

to relevant, personalized content, and therapies (van den Bemt et al., 2019). Driving a next-generation HCP portals with natural language processing (NLP), Chatbots ease the literacy barrier and leverage AI enabled on-demand access to information for peer-to-peer opinion research to improve care delivery while expanding access opportunities (Kudumala et al., 2021).

3.3 Humanoids and Robots

Artificial intelligence-driven robotics technology has advanced significantly in recent years (Pekkarinen et al., 2020) in a variety of industries, including healthcare (Johansson-Pajala & Gustafsson, 2020). Healthcare robots are starting to assume more prominence in helping people preserve their autonomy and caregiving responsibilities (Hosseini & Goher, 2017). With the aid of robots, elderly people can live independently at home, while healthcare professionals can operate more effectively in hospitals. Elderly people, healthcare professionals, family members, and the public have praised assistive technologies. More ubiquitously, healthcare robots are used to aid practitioners – such as surgical, radiotherapy, rehabilitation robots, nursing (Dankar and Badr, 2022) and laboratory robots. Robots are also assistive. Physically assistive robots (PARs), that are service robots that help individuals with daily duties (Hung et al., 2015), or Socially Assistive Robots, companion robots used to boost one's psychological well-being are known as socially assistive robots (Hersh, 2015).

3.4 Chatbots

Akin to their humanoid cousins, chatbots are usually a software agent that simulates human conversation (either written or spoken), allowing humans to interact with digital devices as if they were communicating with a real person. The capabilities of this software agent are natural language and image processing, learning related to reasoning and planning, and finally social and environmental interaction (Tellex et al., 2020). The goal of chatbots is to foster access to information on referral sites through a natural conversational experience and improve the handling of queries by healthcare staff to avoid clogs and slowdowns in care delivery (Laranjo et al., 2018; Jovanović, 2020; Kurup & Shetty, 2022). For example, working through a partnership with INAIL (Italian Institute for Industrial Accident Insurance), Microsoft has made its Healthcare Bot available to Italian

diagnostic units prepared for coronavirus emergencies (Duangdee & Lalitrojwong, 2021). The Intelligent triage assistant – COVID-19 "INAIL", can be easily adopted or customized by institutions of any size to deal with the pandemic through better self-assessment of symptoms.

3.4 Remote Patient Monitoring (RPM)

Remote patient monitoring (RPM) is another example value-based healthcare, increasing access to healthcare services while optimising costs. RPM consists of observing the health status of patients outside medical facilities by employing integrated measurement devices in wearables or patient attached sensors. Such elements can be adapted to the needs of the person being monitored, the type of disease and parameters to be monitored, and to the requirements and capabilities of the medical facility or service provider services. Currently, most measuring devices work with technologies adapted for remote monitoring of patients. Different standards are used for wireless data transmission: Bluetooth, Wi-Fi, or GSM. Some measurement devices detect specific parameters and automatically send results without actively involving the user (e.g., biosensors or wearable devices) (Townsend et al., 2011). The most frequently monitored parameters are temperature, body weight, blood pressure, blood saturation, heart rate, and blood glucose (Mohammed et al., 2019). All data is stored in a cloud repository aggregation and analytics (Celesti et al., 2019). Patients, no matter their SDOH status, are under continual care by specialists who have real-time access to up-to-date information on their health. RPM saves time, helps patients maintain greater independence, and reduces the risk of complications (Yeter et al., 2021).

4 Motivational Drivers

In this section, we loom through the lens of the A4A approach and explicate motivational drivers for our technology actors in a learning healthcare ecosystem, engaging in a cognitive alignment around meaningful and informed interaction of these actors (Badr et al., 2022). The equifinality of patient centeredness promotes timely and effective decision making for equitable and sustainable outcome.

4.1 Universal Access to Care

Following the concept of shared intentionality (A4A), recognizing factors and constraints that influence each agent should lead to the development of shared purpose - Varied health burdens require regular access to care, self-efficacy, activation, and engagement (Knighton et al., 2018). In an equitable healthcare ecosystem, telehealth applications for at home care (Allard, 2020), for instance, provide a robust, comprehensive telehealth coverage, critical to improving access and quality of care and services, particularly for under-resourced populations (Curfman et al., 2021).

Telehealth services are available for specialty care at a distance (Liddy et al., 2019), pediatrics (Cahan, et al., 2020), even Tele-Midwifery and Telenursing (Sinclair, 2010) that provide education across the societal composition and geographic distances of the population. Course of preparation for childbirth by videoconference, to support women in a delicate moment like that of pregnancy and to limit the risks related to possible contagion, for instance (Silverio et al., 2021).

Virtual health may increase access to health care for many people, yet it may also exacerbate equity issues for those who have limited access to new technologies or who are technologically inept. Equitable integrated healthcare treatments would then require patient counselling, education, alert and monitoring, and communication (Knighton et al., 2018). Clinical consultations must accommodate patient technology demands for virtual visit preparation, as well as add new components for a better understanding of all participants' viewpoints.

4.2 Cognitive Alignment - Meaningful and informed interaction

Equity in healthcare access and service coverage includes the ability to make decisions, assess need and physical accessibility, as well as personal economic, social and cultural variables that influence access (Carroll et al., 2022). Interventions, often facilitated by technology, increase the potential improving health care outcomes by addressing patient resource, communication, and navigation barriers; these interventions are connected to (1) disease or condition type; (2) phase of the care process; and (3) technology accessibility in many cases (Knighton et al., 2018).

Health care providers must have the skills and ability to initiate change and define the future of their discipline and practices for developing high-quality care inside the digital ecosystem in order to help shape these new practices (Wiljer et al., 2021).

In order to make sense of the vast amount of data available to power AI technologies, practitioners and technology companies must interact to co-create, promote, or support innovation and insights that can potentially improve decision-making and healthcare fairness. High-quality data are necessary for healthcare research to achieve the quintuple goal, which incorporates care equity in its fundamental principles of quality care (Filliettaz et al., 2021).

4.3 Resource Integration - Timely effective decisions

Artificial Intelligence (AI) is the science and engineering of making intelligent machines, with all what it entails of technology, data management and analysis components. AI technologies can greatly improve self-care options for persons seeking self-treatment or health-related information (Luxton, 2016). The top goal of AI is to build machines that are capable of performing tasks (e.g. Chatbot, robots and decision systems) that we define as requiring intelligence, such as reasoning, learning, planning, problem solving, and perception (Luxton, 2016). The use of intelligent care-providing machines also extends the benefits of telehealth services by availing services to care seekers in remote geographical areas and open access to specialty care services that may not be available in the patient's area. For instance, people who reside in areas without a sufficient population of mental healthcare practitioners can benefit from interactive virtual human care providers.

Accessible anywhere and at any time, even on mobile devices, virtual care avails information about health conditions, conduct question-and-answer assessments, deliver self-care counselling and therapeutic interventions. By integrating data from other intelligent devices such as environmental sensors, wearables, and biofeedback devices, intelligent systems can further customize services to the clinical needs of patients.

The confluence of technologies such as IoT and Cloud help fuel the capture, treatment and availability of data with the help of intelligent mobile and wearable devices to afford self-carers the possibility to monitor the progress toward individualized health goals. Machine perception is a form of AI powered by the

necessary hardware and software to recognize images, sounds, and touch, and even smell (i.e., machine olfaction) in a manner that enhances the interactivity between humans and machines, of which, Natural Language Processing (NLP) is an example. Ultimately, it can be argued that collaborative platforms, cloud computing, and artificial intelligence are strategic in healthcare to handle requests more quickly and effectively, providing benefits for healthcare workers, citizens and the entire healthcare ecosystem.

This favourable state of actor involvement serves as the basis for ongoing information exchange and resource sharing necessary to guarantee sustained value despite changing ecosystem conditions. Such resource integration is critical for a system of actors to emergence in action. Once a care decision has been made, resources must be integrated to provide ongoing and accessible treatment to all groups of patients, regardless of location, social issues, or other limitations that can limit patient movement to the point of care.

However, the growing usage of algorithms in a variety of medical professions increases the risk of health inequities. To improve data collection and coding, more clinical participation is required (McGuckin et al. 2022). The concept of digital compassion and digital empathy should grow, since AI work may mitigate, exacerbate, or perpetuate existing disparities, especially in times of pandemic (Röösli & Hernandez-Boussard, 2021). Those in charge of AI in healthcare must ensure that algorithms are objective and fair, as well as accurate. Because many clinical trial protocols and diagnostic tests consider the race and ethnicity of the patient, a debate has developed over whether this selection is evidence-based.

4.4 Equifinality of Patient Centeredness

For people who have difficulty accessing medical care, remote monitoring allows regular health checks and consultations, health status, and medical consultations (Bombard et al., 2018). They allow rapid consultation with a medical specialist, facilitate the initiation of treatment and accelerate the adjustment of a treatment therapy (Gandy et al., 2021). Medical personnel can simultaneously monitor more patients and spend more time on communication and patient education, a key aspect in the prevention and control of chronic diseases (Paterick et al., 2017). For example, companies that provide remote patient monitoring solutions, present a complete ecosystem of scalable and interoperable products

that can be adapted to many needs, either by modifying and adding new devices or by integrating with external systems.

Research and companies are increasingly moving toward patient-centeredness, a concept that dates back decades (Greene et al., 2012). Patient-centeredness is more than just providing good quality care, it means turning patients into equal partners and putting them at the center of healthcare decisions (Saha et al., 2008): from patients to ecosystem actors for value co-creation (Ciasullo et al., 2017). Co-creation with the patient could change the decisions made by companies in the field, all along the process, including what to research, how to develop it, how to package and distribute it, and finally how to measure the results (Zhang et al., 2015; Birnbaum et al., 2015; Zhao et al., 2015; Marsilio et al., 2021).

Therefore, the steps that can be researched are co-ideation, co-design, co-evaluation, co-testing, and co-launch (Russo Spena & Mele, 2012). Digital and data solutions can help integrate patient-centricity along the value chain. Tracking consumer interest and actual use of technologies allows life sciences companies to focus more on the patient.

Equitable access must consider all age groups. Children, for example, face specific challenges during examinations, including the level of participation of the child during video conferences and the need to rely on another person to elicit physical indications in order to make accurate diagnoses (Gattu et al., 2016). Disparities in telehealth's impact on the workforce treating children, as well as its social consequences, have been identified in the literature, indicating that there are opportunities to establish a more equitable care delivery paradigm (Nguyen et al., 2022). As telehealth for paediatric populations becomes more widely applied, complex issues such as prudence, acceptability, design, interoperability, effectiveness, diffusion, cost-effectiveness, adaptability, monetizability, and security can help assure equity (Cahan et al., 2020).

The technical gap in the patient population must also be addressed. Patients who do not have a smartphone, for example, can still communicate with healthcare professionals by SMS. Older people, on the other hand, have restricted access to Internet-based services due to their low socioeconomic status and inadequate digital literacy; this disparity around telemedicine may exacerbate mental health issues and widen global health disparities (Zhai, 2020).

Trust in technology, design, cognitive impairment, and physical limitations such as poor vision, hearing, or sensory impairment are among the issues that telemedicine for the elderly faces (Tan et al., 2020). Without such efforts, tools

may represent the many different ways that data, computational, and analytic biases can be produced, resulting in increased inequity based on race, ethnicity, gender, and other sociodemographic variables connected to uneven health outcomes (Clark et al., 2021).

4 Conclusions

Enabled by innovations in digital health technologies, Value-Based Healthcare becomes be predictive, preventive, personalized, and participative (Baiardini & Heffler, 2019). The ability to create and integrate the knowledge base for exchange, management, re-use, sharing of information and responsible management of common data are key drivers of the evolution of societies, the progress of humanity and competitiveness. For a sustainable smart city, an adaptive capacity is becoming more and more important, requiring timely innovation technological and social innovation (Yigitcanlar et al., 2018). This leads to improved productivity where all actors, including the underprivileged can produce higher values that can be reflected in citywide economic growth. When cities attract skilled knowledge workers, they can bring new ideas, innovation, and prosperity (Spohrer and Maglio, 2008).

Alberti et al., (2013) recognized that driving "legislative actions regarding payment reform, health information technology, community health needs assessments, and expanding health equity research could be woven together to build an evidence base for solutions to health care inequities", by reducing unwarranted variations in care to maximize the value of healthcare for populations (Cheung and Gray, 2013). Enabled by innovations in digital health technologies, Value-Based Healthcare becomes be predictive, preventive, personalized, and participative (Baiardini & Heffler, 2019).

By functioning in this type of dynamic, a virtuous circuit of value cycles is leveraged to stay adaptive in the face of change. The value created by universally accessible care, through collaboration from digital actors in the ecosystem generates meaningful and informed interactions that can yield timely and effective decisions (Figure 1).

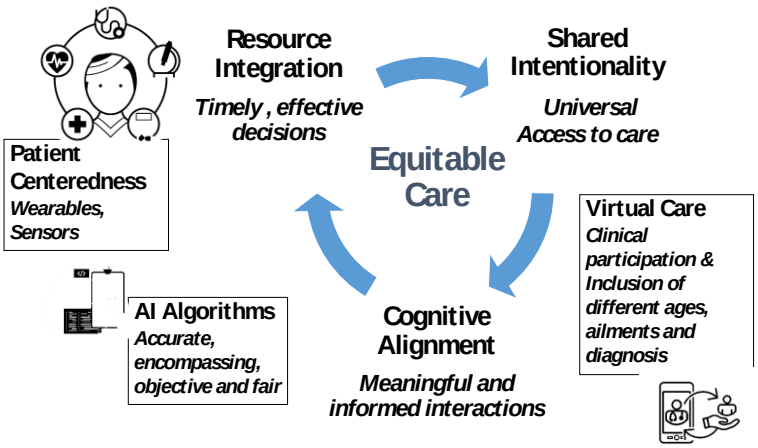

Figure 1: Digital Actors in Equitable Healthcare Service Ecosystem.

Complex smart service ecosystems are the outcome of systematic methods of continuous learning, timely data collecting, rational innovation, social responsibility, and network governance, rather than basic intuitions (Spohrer et al., 2011). Resource integration reinforces the shared intentionality for equitable care closing the cycle though cognitive alignment that maintains levels knowledge integration necessary to provide equitable care. Information gained from diverse actors in the healthcare ecosystem is at the heart of its processes, fostering long-term progress (Badr et al., 2020). The capacity to construct and integrate a knowledge base for the interchange, management, re-use, and sharing of information, as well as the responsible management of shared data, are fundamental drivers of society's growth, humanity's progress, and competitiveness. The goal of smart cities is to utilize technology to connect diverse infrastructures and services, as well as to better understand social aspects in order to construct human infrastructures and governance for institutional reform and public participation. Smart cities are said to have three primary goals: increased production, sustainability, and livability (Kim et al., 2021). Therefore, our digital health technology actors, become the cornerstone of value based healthcare that uses of evidence based decision making (to ensure that only interventions with strong evidence of cost effectiveness are used), emphasizes quality improvement (to improve outcomes), and cost reduction and to increase the value that is derived from the resources available for a population. Hence, the condition remains that in this debate's background, lest there be superficiality

and demagoguery, there should be real cooperation of all the actors involved in the ecosystem for the achievement of the quintuple-aim analyzed here.

There is a need to redefine a new set of values that will have to govern relations between the various areas of a world that is now globally connected at a time when common, truly universal demands are emerging, among them the right to health. It seems, therefore, desirable that what might be called a universal health consciousness be formed toward increasingly equitable and value-based care in which all actors are involved, as well as the digital ones.

5 Contribution and Limitations

In conclusion, the paper makes several contributions to the field of healthcare augmented by digital technologies. First, it introduces the Actor-for-Actor (A4A) approach, which can clarify the engagement and relationships between actors in healthcare processes. This approach can help identify the structural prerequisites of engagement and the determinants of system commitment to the value of equitable care delivery. Second, the paper demonstrates how digital technology actors, such as artificial intelligence and robotics, can support the healthcare ecosystem, particularly in telemedicine and remote patient monitoring. Through the use of these technologies, it is possible to provide equitable care to the population, in accordance with the quintuple performance aim of the healthcare system.

However, this paper also has limitations. One limitation is that the paper is practical because it illustrates use cases but with a conceptual perspective and does not provide an in-depth analysis. Although the paper highlights the potential benefits of digital technology, it is important to consider the ethical considerations of the use of digital technology in healthcare and their potential risks and unintended consequences that could occur. Another limitation is that the paper focuses mainly on the perspective of healthcare professionals and digital technology actors, rather than that of the patient. Future research could explore the patient's perspective and the impact of digital technology on patient outcomes and experiences with more in-depth analysis. Despite these limitations, this paper highlights the potential of digital technology in supporting value-based and equitable healthcare. By identifying the structural prerequisites of engagement and leveraging digital technology actors in the healthcare

ecosystem, there is a way forward in working to improve healthcare outcomes and reduce health inequalities.

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Does Quality Accreditation Stimulate Effective Leadership in Health Care Organisation?

Valentina Masci*

University of Parma
Via J.F. Kennedy, 6 – Parma, Italy

Lorenzo Pratici

University of Parma
Via J.F. Kennedy, 6 – Parma, Italy

Andrea Francesconi

University of Trento
Via Vigilio Inama, 5 – Trento, Italy

Gianluca Lanza

University of Parma
Via J.F. Kennedy, 6 – Parma, Italy

Antonello Zangrandi

University of Parma
Via J.F. Kennedy, 6 – Parma, Italy

** Corresponding author*

Abstract

Quality improvement is, for most countries, a central objective of health care system reform and service delivery, which is why health care managers must devote a great deal of attention and resources to ensuring a high quality of care for patients and must continuously strive to improve it.
Within healthcare organisations, managers have an important and obvious role to play in the quality of care and patient safety and this is certainly one of their main priorities everywhere.
However, it is not always easy to understand how to improve quality: there are numerous issues that healthcare managers have to deal with.

To assist and evaluate health managers in quality development, effective methods have been implemented and promoted at national and local levels, including external quality assessment mechanisms.
Many countries have a set of voluntary or statutory mechanisms for periodic external assessment of organisations against defined standards; these include ISO standards, which provide standards against which organisations or functions can be certified by accredited assessors. However, the ISO standards define the minimum level required and their evaluation is only done on documents. For this reason, other bodies, such as The Joint Commission International (JCI), have developed new standards and evaluation methods. The JCI method consists of stimulating the demonstration of continuous and sustained improvement in healthcare organisations through the application of shared international standards, international patient safety targets and the measurement of indicators.
This research aims to outline how the JCI method can improve the work of managers in improving organisational performance.
A qualitative approach is used to answer the research question and semi-structured interviews will be administered to a selected sample of CEOs of JCI accredited healthcare organisations in Italy (out of a universe of 24 total accredited healthcare organisations).
The questions to be asked will investigate three main areas: (1) the role of quality accreditation in better defining responsibilities among managers; (2) how quality accreditation can be used as a tool to improve organisational leadership; and (3) how quality accreditation can help health care organisations better achieve their performance goals.
Interviews will be transcribed and analysed using qualitative data management software (Dedoose), which involves the use of a pattern recognition process in which emerging themes become categories for analysis. The coding framework will be developed by all researchers involved in this work using a joint blind coding approach.
The expected results of this research will help to shed light on the differences brought about by quality accreditation in organisational performance: already accredited institutions will then have the task of sharing their experience to highlight the positive and negative aspects of accreditation.

Keywords – Quality, leadership, Joint Commission International, Organizational performance, Quality accreditation.

Paper type – Academic Research Paper

1 Introduction

Quality has become an important concept in our lives. Users are always looking for quality products and services (Mosadeghrad, A. M., 2012). The existence of this need for quality has caused companies and organisations around the world to consider quality as an indispensable component of every service and production process (Chassin et al., 2013). Quality is therefore considered by

companies as a strategic differentiation tool to gain a competitive advantage (Cham et al., 2020). By improving quality through the improvement of structures and processes, it is possible to achieve a reduction in waste, rework and delays, a reduction in costs and an increase in patient satisfaction (Lagrosen et al., 2005, Rahaman et al., 2001); all leading to an increase in the effectiveness and efficiency of the organisation that benefits users and employees (Alexander JA et al., 2006). The term 'quality' can take on different meanings, which can make the term take on a more traditional or a more strategic definition (Aggarwal et al., 2019). For example, The American National Standards Institute (ANSI) and the American Society for Quality (ASQ) define quality as the set of characteristics of a care or service that affects its ability to meet certain needs (Bodade et al., 2021). Within the TQM (Total Quality Management) concept, which stands for an approach to quality extended to all business functions (Zamolo D., 2015), quality is defined as a strategy focused on user needs (Anubha et all, 2018). Joseph M. Juran (2010) defined quality "as compliance with requirements".

Very often in health care, quality is determined and evaluated by the expectations of health care providers and professionals (Aggarwal et al., 2019). The quality of healthcare delivery is determined by patient satisfaction, is based on patient expectations, and is linked to training and interpersonal relationships (Mandeep et al, 2014). It is very important to define, measure and improve the quality of health services. Quality has a subjective nature and intangible characteristics, that is why it is very difficult to define (Mosadeghrad, A. M., 2014). The quality of healthcare services is even more difficult to define and measure than in other sectors because the distinctive features of healthcare, such as intangibility, heterogeneity, and contemporaneity, make it difficult to define and measure quality (Joss R. et al, 1995, Naveh E. et al, 2005), Furthermore, it has been added that the quality of health services also depends on the health care provider because there may be differences in background, experience, skills and personal characteristics between them (Mosadeghrad et al., 2012). Another characteristic of the health service is that it is dependent on the service process and the interactions between customer and service provider (McLaughlin et al., 2006). There are also some attributes of health service quality, such as timeliness, consistency and accuracy are difficult to measure beyond a subjective assessment by the customer (Mosadeghrad, A. M., 2014). Quality in health care can be defined as the application of medical science and technology to maximize the health benefits they create without increasing the risk for the patient (Donabedian

A., 1980). Quality in health care can be defined as the application of medical science and technology to maximize the health benefits they create without increasing the risks to the patient (Donabedian A., 1980). quality can be divided into three components: 1) technical quality, 2) interpersonal quality and 3) services (Haddad et al., 1998). Technical quality refers to the effectiveness of care in producing a health gain. Interpersonal quality refers to the ability to meet patients' needs and preferences. Finally, services include characteristics such as the comfort of the physical environment and attributes of the organisation of services (Donabedian A., 1988). Øvretveit (2009) defines quality care as the "provision of care that exceeds patient expectations and achieves the highest possible clinical outcomes with the available resources". He has also developed a system to improve the quality of healthcare based on three dimensions of quality: professional quality, customer, and management quality (Øvretveit J., 2009). Professional quality is based on the professional's opinion that consumers need have been met using correct techniques and procedures. Customer quality is based on the fact that the direct feel they are getting what they want from the services. Management quality is about ensuring that services are delivered in a resource-efficient manner (Øvretveit J., 2000).

Therefore, quality improvement is, for most countries, a central objective of health system reform and service delivery (Li et al., 2020). Within healthcare organisations, managers have an important and obvious role to play in quality of care and patient safety and this is certainly one of their top priorities everywhere (Parand et al., 2014). However, it is not always easy to understand how to improve quality: there are numerous issues that healthcare managers have to deal with (Price et. Al., 2020). For example, access and continuity of care, clinical effectiveness, patient safety, value for money, consumer responsiveness and public accountability of services are just some of the issues that managers may encounter (Dykgraaf et al., 2021). To assist and evaluate healthcare managers in developing quality, effective methods have been implemented and promoted at national and local levels, including external quality assessment mechanisms (Shaw et al., 2002). Many countries have a set of voluntary or statutory mechanisms for periodic external assessment of organisations against defined standards (Shaw et al., 2002); these include ISO standards, which provide standards against which organisations or functions can be certified by accredited assessors; they were originally conceived for the manufacturing industry (e.g., drugs, medical devices), then applied to healthcare, particularly radiology and laboratories (Pomey et al.,

2010). However, ISO standards define the minimum level required and their evaluation is only done on documents. For this reason, other agencies, such as The Joint Commission International (JCI), have developed new standards and evaluation methods (The international joint commission standards for hospital accreditation). The JCI method consists of an accreditation process comprising a series of initiatives aimed at responding to the growing worldwide demand for an objective methodology for the evaluation of health services based on quality standards. The aim is to stimulate the demonstration of continuous and sustained improvement in healthcare organisations through the application of shared international standards, international patient safety targets and the measurement of indicators. Accreditation, therefore, is considered a reliable tool for assessing and improving the quality of healthcare (Hussein et al., 2021). JCI, like other accreditation bodies, has the task of providing accreditation to hospitals to improve quality and patient safety. (Alkhenizan & Shaw, 2011). JCI is the biggest international accreditation organization, it offers a huge number of guidelines for accreditation (Naveh et ai., 2005). JCI accreditation aims to certify that accredited facilities possess certain characteristics such as, for example, management integration, communication to the public and confidence building, quality and safety, and international profile (Tabrizi, Gharibi, & Wilson, 2011). International certification can be useful to improve international recognition of healthcare institutions and demonstrate excellence in medical quality (Oh et al., 2013). However, its effect on performance and outcomes remains unclear. The aim of this research is to try to understand how quality is implemented within healthcare institutions and the actions that healthcare management can take to try to improve it. In addition, an attempt will be made to illustrate how and whether or not JCI accreditation helps the migration of quality within healthcare organisations.

2 Method

The research question implies the use of a qualitative approach. A selected sample of chief medical directors has been selected among the 25 Italian health organisations listed as JCI-accredited. Thee methodology selected relies on privileged observer theory (Della Porta, 2014; Pratici et al., 2022), selecting respondents which are at the same time involved in the phenomenon and being at the top hierarchy of the organisations analyzed.

Two criteria have been followed to better define the sample: respondents had to (1) have been a chief medical director of a JCI-accredited organization for at least one consecutive year, and (2) have previous experience in other non JCI-accredited hospitals.

We invited 17 interviewees, out of the 25 total respondents meeting the defined criteria in Italy. However, only 9 of them accepted the invitation (36% of the total universe considered).

Even if the percentage of interviewees compared to the total universe seems high, the low overall number of interviewees made impossible to run a structured interviews Therefore, we opted for a non-structured approach (Kvale, 1994).

Interviews consisted of 5 questions:

1. Quality development is a strategic goal of healthcare organisations: in which document does your approach to quality be described?
2. How does your medical directors organize the work to pursue quality development?
3. What tools does medical directors use to assign quality strategic goals at an operational level?
4. How does JCI accreditation help units' directions to better manage the organization?
5. What are the strengths and weaknesses of Italian NHS mandatory accreditation and international voluntary accreditation?

Interviews were thus transcribed and coded using a qualitative data management software (Dedoose®). A process of pattern recognition is used where emerging themes become categories for the analysis (Aberbach & Rockman, 2002; Della Porta, 2014; Price et al., 2020).

The coding framework was developed by all researchers contributing to the writing of this paper, in a joint process of double-blind coding (Price et al., 2020). The framework made it possible to identify the flows of information, characterizing key elements high- lighted by the interviewees, in both positive and negative meanings (Pratici et al., 2022).

3 Results

Responses from the nine organisations have some common elements we have below described question per question:

3.1 Quality development is a strategic goal of healthcare organisations: in which document does your approach to quality be described?

All respondents provide evidences about the fact that quality strategic goals in their organization have been described and formalized into top strategic documents. Generally speaking the document where quality goals have been described are broad strategic documents integrated that could represent the approach of the entire organization to the quality improvement and patient safety.

Majority of organisations identify this document as "Quality and Patient Safety Plan", in some case this document is the "Organization Strategic Plan".

3.2 How does your leadership organize the work to pursue quality development?

Organizational models in Italian healthcare sector are not uniform, you can find differences according to the ownership (public vs private) and the mission (specialized vs generalist).

Responses highline some common characteristics:

- Direct link between quality department/unit/office and leadership: all organisations have identified an organizational unit with a specific goal about quality improvement with a direct connection (hierarchical or functional) to the leadership;
- Functional connection among quality department/unit/office and the other units focused on patient safety (risk management, facility management, infection control, …)

Differences are related mainly to the dimension of the organization, the more the organization is structured the more are developed functional connections to the medical units/Departments.

3.3 What tools does your leadership use to assign strategic quality goals to the operational level?

An organic approach to the quality improvement reflects the organizational choices of how to implement quality goals into operational activities. Moving from this perspective the strategic documents where all the goals are identified (see Q1) is the same tool used to evaluate how they are implemented. All

organisations have identified in the strategic documents the strategic responsibilities for each quality goal.

Organisations move from the strategic level (long-term) to the operational one (annual) using the "budget", tool used to identify multi-dimensional goals at unit level. All the organisations identify specific quality goals into the budget of each unit. For each goal have been identified: responsibility (who is in charge of reaching the specific goal) and indicator (how to measure if the goal has been reached).

How to define the quality goals is different among organisations. Majority of organisations have put in place a top-down process to identify them, a minority part of organisations have a bottom-up process and only one organization has in place a mix of both processes.

3.4 How does JCI accreditation help your leadership better manage the organization?

The impact perceived of JCI accreditation is an organic one, responses from organisations identify some areas where they have evidences about the fact the accreditation help them in facing some organizational issues.

Organization responses help us to identify 5 main areas of impact:

- All organisations agree on recognize to JCI accreditation a role in changing the way of orienting the governance approach to patient safety and quality improvement and increasing the level of cohesion for all the different organizational activities.
- A second main area of improvement recognized is on the ability to overcome the limit of the approach "per units", typical into the Italian NHS, to a patient centred one. Organization is more oriented to work per process focusing on the patient output/outcome as an integrated and unique result of a multidimensional clinical approach more than just a sum of different actions.
- Third area is the increasing knowledge about disaster management. Responses identify a strong and organic approach of accreditation in "preparing" organization to face maxi-emergencies both clinical (Covid) or structural (Fire emergency).
- A fourth area of impact is strongly linked to risk assessment. Accreditation helps organization in developing an integrated approach

to the risk management; defining a unique plan for all risks allow to have a more clear control and interaction of different units involved into managing it. Defining measurable goals and clear responsibilities but from a shared team have a positive impact on the organization safety culture.

- A fifth area, identified in the responses, refers to Clinical Governance. JCI Accreditation, with the implementation of privileging, helps organisations to better assess and map the competences of their physicians in order to better match them with the patient needs. Furthermore privileges allow organisations to plan and develop educational programs to face competences losses because of retirements or discharges.
- Last area identified in few organisations (because of the nature of them) is the increasing integration developed between clinical activities and teaching/research part.

3.5 What are the strengths and weaknesses of Italian NHS mandatory accreditation and International voluntary accreditation?

Organisations recognize different goals for the two accreditation tools (Italian and International).

Italian NHS mandatory accreditation is recognized as a useful tool to set the minimum standards necessary to provide care into the NHS. On the other hand it is perceived as a bureaucratic tool more oriented to check the alignment to the law than providing support in increasing quality of care.

International voluntary accreditation helps organisations in involving all the different parts of the organization to the common goal to improve quality and patient safety. They recognize an impact on the accreditation on the way of acting (behaviours) of professionals and units, in particular thanks to its orientation to evidence based approach. Accreditation is recognized as a competitive advantage for the organization both for its brand and for the fact that it improve the effectiveness of the clinical governance activities. On the other hand, a limit of the accreditation is its international nature that does not help a strong link with some national and local rules.

4 Discussion

Leadership has a key role into orienting the action of the healthcare organization to quality improvement creating the conditions (mission, vision, tools, …) and the commitment necessary to be effective (Fanelli et al., 2017).

Leaders interviewed recognize the key impact of quality improvement into the way of managing (Chassin et al., 2013) effectively and efficiently (Øvretveit J., 2000) the organization. From the responses is quite clear that quality is perceived as part of the managerial process: identification of units/departments/office with a direct link to leadership and a clear responsibility on it. Defining quality improvement goals into the strategic plan guarantee the impact on the long-term sustainability of the organization itself. Developing the goals from the strategic level to the operational one, including them into the budget tool so they are linked to the organizational and individual performance system, reinforce their impact also on the short-term (annual).

International Accreditation has been perceived differently from the Italian NHS. Italian one is recognized as a tool useful to uniform at the same minimum level healthcare organisations but it is more oriented to check in a bureaucratic way the evidence from law than really checking quality standards. International accreditation is perceived as a useful tool to better manage the organization (Alkhenizan & Shaw, 2011). It has impact on how professionals act at clinical level (patient centred approach), on support activities (risk management, facility management) and on facing emergencies (Disaster Management).

5 Conclusions

In healthcare organisations, the concept of quality is directly linked to the organisation's core business as well as to the clinical culture.

These two features make it possible to state, as the research shows, that quality improvement strategies are, in healthcare organisations, catalysts for the exercise of clinical leadership at different levels of responsibility.

Through the search for quality patient need satisfaction and effective professional action are both simultaneously pursued. This statement, as our analysis shows, is even more true where healthcare organisations

- see quality as an essential element of their strategy;
- link quality goals to well-established systems of management by objectives and budgeting where present;

- opt for voluntary accreditation systems rather than institutional accreditation systems.

With regard to this last aspect, our research provides evidence of how institutional accreditation logics and mechanisms, especially in the case of Italian public hospitals, can be misrepresented. In fact they may be perceived similar to bureaucratic logics and tools of governance of public health organisations not consistent with the clinical culture of professionals, not understood by clinicians and considered mere formal requirements rather than opportunities.

This is not the case for voluntary accreditation which, if well managed, can activate virtuous circles of improvement by stimulating the exercise of clinical leadership and improving the overall effectiveness of clinical governance action.

Therefore, the existence of a voluntary accreditation system allows the organisation to value professionals as capable of giving a quality footprint to all their actions and also legitimises their intervention from an organisational point of view.

We believe that such evidence is certainly of interest in stimulating more in-depth future research on this subject. Further research is also necessary in view of the limitations of our study based exclusively on experiences deriving from the Italian context. An extension of the research to different national contexts is needed to validate and generalize the results of the study.

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How Individual Level Factors Impact Digitalization in SMEs: An Empirical Analysis in the Wine Industry

Livio Cricelli

Department of Industrial Engineering
University of Naples Federico II
P.le Vincenzo Tecchio, 80

Roberto Mauriello

Department of Industrial Engineering
University of Naples Federico II
P.le Vincenzo Tecchio, 80

Serena Strazzullo*

Department of Industrial Engineering
University of Naples Federico II
P.le Vincenzo Tecchio, 80

** Corresponding author*

Abstract

In modern society, digitalization has become increasingly pervasive, both in the lives of individuals and in business activities. Research thoroughly analysed the advantages and challenges of digitalization, suggesting that this not only involves the adoption of new technologies but also requires significant changes in the processes and capabilities of the firm. As such, human resources are among the most affected by companies' digitalization. Despite this, we observed a lack of studies investigating the interplay between companies' digitalization and individual responses. Most studies focus on analysing how digitalization affects individuals but fail to explain how individuals can, in turn, influence companies' digitalization. Aiming to help bridge this gap we first performed a thorough literature review to identify the main individual-level factors influencing companies' digitalization. Among these, we included digital skills, skills and capabilities, culture, and top management support. Then, to support literature results and lay the foundation for new theory development, we used a rigorous case study methodology to provide empirical evidence of how individual responses affect SMEs' digitalization. Specifically, we performed a series of semi-structured interviews with the managers of 4 Italian SMEs in the wine industry. We chose to focus on the wine industry since it is a sector characterized by both great opportunities, and significant obstacles to digitalization.

Ultimately, our analyses show that SMEs' digitalization is significantly affected by the management's actions, which also affect digital skills and organizational culture. Indeed, companies realized the importance of digital transformation and tried to foster it by hiring new professionals and by rethinking management processes. At the same time, SMEs lack the resources to invest in the development of advanced digital knowledge and skills. As a result, individuals still lack advanced digital knowledge and show strong resistance to the introduction of innovative solutions that would radically change traditional production processes. One of the tools that SMEs can leverage to overcome these obstacles is collaboration with external partners, who can provide the technology and digital skills needed without requiring direct investment by the companies.

Keywords – Digitalization, Agri-food, Case study, SME.

Paper type – Academic Research Paper

1 Introduction

In modern society, digitalization has become increasingly pervasive, both in the lives of individuals and in business activities. While literature still lacks a unique, shared definition of digitalization, this can be broadly understood as the transformation of analogue information into digital data. Furthermore, common to many definitions is the idea that digitalization entails the use of digital technologies to improve business performance, in terms of economic results and value creation (Ritter & Pedersen, 2020; Vial, 2019). Indeed, researchers thoroughly analysed the advantages that digital technologies can provide to companies. These include improved efficiency, cost reductions, and a higher awareness of consumers' demands and market dynamics (Khin & Ho, 2019; Parviainen et al., 2017). On the opposite side, the literature highlights that digitalization also comes with significant challenges. The adoption of digital technologies often involves an evolution of the business model, which not only affects the value proposition but also significantly impacts firms' processes and resources (Bouwman et al., 2018; Rachinger et al., 2019).

Recent literature suggests that human resources are among those most affected by the digitalization of the company (Mazurchenko & Maršíková, 2019). For example, by changing processes and activities, digitalization often involves a redefinition of roles and responsibilities and requires the development of new skills and capabilities (Eller et al., 2020). Also, the adoption of digital technologies typically affects information and data management (Kristoffersen et al., 2020).

Again, individuals are not only required to adapt to new technologies but also to new mechanisms of communication and knowledge sharing (Faraj et al., 2018). Finally, digitalization often entails new standards and control mechanisms, which may significantly influence the work of individuals (Wilkesmann & Wilkesmann, 2018).

Overall, the literature suggests that there are many ways digitalization can affect individuals in firms. At the same time, we observe a lack of studies analysing how human resources can in turn influence the digital transformation of companies. Most works focus on investigating the impact and requirements of digitalization for human resources management (Mazurchenko & Maršíková, 2019; Strohmeier, 2020). While these studies highlight the key role of individuals, few studies discuss the competencies and skills needed to successfully adopt new technologies, focusing on the interplay between digitalization and individual responses (Caputo et al., 2019; Tataru, 2019). In this paper, we try to help bridge this gap by investigating how individual-level factors affect companies' digitalization. Thus, we also aim to provide managers with useful practical suggestions to effectively manage companies' digital transformation. Specifically, we aim to answer the following research questions:

- What are the individual-level factors influencing companies' digitalization?
- What is their impact on the digital transformation of the company? And how can managers leverage these factors to promote sustainable digitalization?

To answer the first question, we conducted a thorough literature review. This allowed us to identify the main individual-level factors that can influence the company's digitalization efforts, including digital skills, culture and management support.

To move our investigation further and provide empirical evidence of how individuals leverage these factors to affect companies' digitalization, we adopted a case study methodology, performing a series of semi-structured interviews with the managers of four Italian agri-food SMEs. Specifically, we chose to focus on the wine industry as we observed that digital technologies have the potential to become key drivers for the evolution of the sector (El Bilali & Allahyari, 2018). At the same time, the digitalization of agri-food supply chains implies a radical change in culture and skills, caused by the transition from an experience-driven to a data-driven form of management (Ingram & Maye, 2020; Klerkx et al., 2019).

This makes the wine industry a particularly interesting research field. Through a rigorous coding activity, we were able to identify key themes and insights, supporting previous results and enriching the debate with new elements. Also, we chose to focus on SMEs as they represent the vast majority of companies operating in the Italian wine industry (Bandinelli et al., 2020). This allowed us to provide the executives with useful practical suggestions to manage digitalization and foster the creation of a work environment conducive to sustainable and effective integration of digital technologies. The rest of the paper is organized as follows: the next paragraph provides the theoretical background underpinning our investigation. It presents the main individual-level factors that affect companies' digitalization. The next section illustrates the methodology we used to select and analyse the cases. In the following paragraph we present and describe the results. In the last sections we discuss the results and draw the conclusions, respectively.

2 Literature review

The adoption of new technologies not only affects companies' strategy and value proposition but also entails profound changes in processes and skills (Verhoef et al., 2021; Warner & Wäger, 2019). Consequently, to reap the benefits promised by digital technologies it is important to understand and manage individual responses. Executives must not only consider how individuals' work and tasks are affected by the introduction of new technologies. It is also necessary to understand how individuals adapt to changes and can contribute to the company's digitalization (Rachinger et al., 2019).

As for the review methodology, the identification of relevant works was carried out using the online database of scientific publications Scopus, known for its reliability and versatility across multiple research fields (Amentae & Gebresenbet, 2021; Parida et al., 2019). Table 1 shows the search string and the results obtained. The string is conceptually composed of four "segments", separated by the conjunction "AND". The first two segments allowed us to bring together studies analysing companies' digitalization in relation to human resource management. In the third segment, we included terms such as "attitude or "behaviour" to include studies investigating individuals' responses to digitalization. The last segment allowed us to focus on the organizational and managerial dimensions. Starting from the 677 initial results, we limited the scope

of the search by defining appropriate selection criteria. First, we included only published articles in English with at least 1 citation, to ensure the quality and relevance of the results. Then, we included only the works pertaining to the subject areas: Business, Management & Accounting, Social Sciences, and Psychology, to align the results with the objectives of the study. Finally, we read the abstracts of the remaining 143 papers, to select only the works investigating how individuals affect companies' digitalization. We then proceeded to a full-text read of the final sample of 84 articles to identify the main individual-level factors influencing companies' digitalization, which will be presented in the next sub-section.

Table 1 Search string and selection criteria.

Search string and selection criteria	**Results**
"digitization" OR "digitalization" AND "individual" OR "HR" OR "human resource" OR "Human" AND "factor" OR "response" OR "attitude" OR "behaviour" AND "company" OR "business" OR "management" OR "organization".	677
Articles in English with at least 1 citation.	233
Subject areas: Business, Management & Accounting, Social Sciences, Psychology.	143
Abstract read.	84

2.1 Individual level factors influencing companies' digitalization.

The literature review allowed us to identify multiple individual-level factors that can influence the digital transition of companies. To provide solid theoretical support to the empirical analyses and present an exhaustive, yet synthetic background, we grouped the factors into four main categories, which we will present next.

Digital skills: this factor concerns the ability of individuals to correctly use digital technologies to improve processes and activities. A fundamental prerequisite is the knowledge of business processes and the understanding of how innovative technologies can change and enhance them (Paiola et al., 2021; Warner & Wäger, 2019). Relevant studies suggest that a significant obstacle to digitalization is the lack of awareness by management or employees of the full potential of innovative solutions, resulting in under-use and under-appreciation (Cetindamar Kozanoglu & Abedin, 2021). Another reason that makes the acquisition and management of digital skills complex is the need to keep them updated. the rapid transformation of businesses and the increasingly short life cycles of technologies require companies to constantly update their knowledge

base (Chetty et al., 2018; Witschel et al., 2019). Managers can hire new staff or invest in training activities. In addition to entailing a cost for the company, these measures could be interpreted by employees as threats to the stability of their position, leading to resistance and conflicts (Scuotto et al., 2021). Conversely, digitally competent personnel can not only be highly motivated, but can actively contribute to digitalization, optimizing processes and suggesting improvements (Blanka et al., 2022).

Skills and competencies: by affecting all aspects of the business, from the value proposition to the processes, digitization requires the development of capabilities that go beyond digital skills. Many relevant studies observe that the adoption of digital technologies changes the role and responsibilities of employees (Neumann et al., 2021; Tataru, 2019). For example, the use of information software changes data acquisition, transmission, and elaboration. In this context, employees can take on new roles and act proactively to use information effectively (Rachinger et al., 2019). Furthermore, one of the main advantages of digital technologies is the automation of operations and data collection processes. This contributes to shifting the role of employees from executors to supervisors and managers, requiring the development of high analytical and problem-solving skills (Brunetti et al., 2020; Sony & Mekoth, 2022). Finally, to manage a high amount of data and support the execution of the new business processes employees are required to develop advanced communication and coordination skills (Caputo et al., 2019; Sousa-Zomer et al., 2020).

Culture: this factor brings together the main psychological variables that influence the behaviour of individuals concerning the adoption of new technologies, including attitude, motivation, expectations, and perceived utility (Solberg et al., 2020; Trenerry et al., 2021). Literature suggests these elements can be either among some of the main drivers or, conversely, the main barriers to the adoption of digital technologies (Isensee et al., 2020; Warner & Wäger, 2019). In general, there are multiple reasons why employees or even managers may be reluctant or may actively resist the digitalization of the company. Some of these reasons are also connected to the factors discussed above. For example, employees' digital skills may be inadequate. In this case, they might resist the change for fear of losing their position or being replaced by new hires (Solberg et al., 2020) Furthermore, the changes entailed by the adoption of disruptive technologies are not limited to the development of digital skills but concern the redefinition of roles and responsibilities (Cetindamar Kozanoglu & Abedin, 2021;

Scuotto et al., 2021). Depending on each individual's attitude and expectations, this can be a strong driver or an additional source of resistance and conflict (Eller et al., 2020; Van Der Schaft et al., 2022). Employees and managers may also be reluctant to change established behaviours and practices, especially if they have led to past successes (Weking et al., 2020).

From a wider perspective, employees may tend to align their behaviours with the organizational culture. For example, employees of a company that has traditionally emphasized the professionalism and independence of its staff may strongly resist the introduction of digital technologies, considering them a source of limitation and control, or interpreting the consequent changes as a devaluation of their efforts (Cinar et al., 2019; Lifshitz-Assaf, 2018). On the opposite side, the employees of dynamic companies with advanced digital capabilities, more favourably oriented towards technological innovation could welcome the change with more enthusiasm (Blanka et al., 2022). In general, it seems extremely important for the company to establish a culture and work environment conducive to innovation to elicit favourable responses from the employees (Imran et al., 2021; Nadkarni & Prügl, 2021). The implications and tools useful to reach these goals will be briefly discussed in relation to the final factor we present.

Top management support: this factor considers how the management can influence the company's digitalization. Relevant studies suggest that executives can act at multiple levels and with different tools to support change processes (Verhoef et al., 2021; Witschel et al., 2019). First, management can direct the firm's efforts through strategic choices. Indeed, the disruptive effect of digital technologies can only be effectively managed by framing the digital transition in an appropriate strategy and business innovation path (Schneider & Kokshagina, 2021; Sousa-Zomer et al., 2020). Furthermore, the management is responsible for acquiring and allocating the resources necessary for the transformation. Executives must evaluate the costs and benefits of the available solutions, schedule activities, and manage human resources to ensure the necessary skills are available (Nambisan et al., 2019; Scuotto et al., 2021). Finally, management attitude is key to developing a culture conducive to the adoption of digital technologies (Cortellazzo et al., 2019; Gupta et al., 2022). Indeed, managers have some key tools to monitor and drive the adoption of technologies. For example, redefining activities can help align the workflow with the new communication and coordination possibilities enabled by digital technologies (Bouwman et al., 2018; Schwarzmüller et al., 2018). Furthermore, adequate control tools, such as reports

or indicators, allow the management to monitor the processes of adoption and adaptation to new technologies. From this perspective, it is important to balance control and autonomy, to prevent triggering negative responses from the employees (Morgan, 2019; Wilkesmann & Wilkesmann, 2018).

3 Case studies

3.1 Methodology

In this work, we use a case study methodology to investigate the interplay between companies' digitalization and individuals' responses. This methodology has been successfully applied to investigate a wide variety of problems in the business management field, ranging from operations to technological innovation management (Furjan et al., 2020; Jonas et al., 2018), and is effective to investigate complex phenomena within their real-life context (Ebneyamini & Sadeghi Moghadam, 2018). A key feature of the case study is the ability to combine empirical, context-specific analyses with existing theories. Thus, this methodology is particularly suited to explore new phenomena and emerging issues, while testing and elaborating on established results (Elsahn et al., 2020; Ketokivi & Choi, 2014). Thus, we contrast empirical findings against literature results, to advance theory and enrich the debate with new elements. In this, we follow Ketokivi and Choi's approach whereby case research must respect the duality criterion. This implies being both situationally grounded and delivering general results.

Specifically, for this study we adopted a multiple case study methodology, investigating how digitalization affected human resources management in 4 Italian SMEs in the wine industry. To select the cases, we adopted the following criteria. First, we decided to focus on the wine industry, since it presents significant opportunities for digital transformation, from cultivation to product management (Lezoche et al., 2020; Miranda et al., 2019). On the production side, digital technologies make it possible to use real-time data to monitor crops and optimize cultivation processes (Liakos et al., 2018; Queiroz et al., 2020). As for product management, the adoption of digital solutions throughout the supply chain can help streamline product flows and enhance traceability (David et al., 2022; Sørensen et al., 2010).

To reinforce this criterion, we decided to focus on companies offering high quality products, which acquired certification or are exported abroad.

Concurrently, we chose to limit the analysis to Italian firms for two reasons. On the one hand, the Italian wine industry is renowned for the quality of its products. On the other, more pragmatically, to ease case identification. We then decided to focus on SMEs, which make up the vast majority of Italian agri-food companies and thus best represent the current state of the industry (Bandinelli et al., 2020). Overall, in the selection of the cases we privileged the presence of common elements, rather than the identification of extreme or significantly different cases. Given the literature gaps we identified, we made this choice to focus the analysis on the current situation and provide a solid basis for future theory development.

Operationally, we contacted 65 companies via email or their websites, illustrating the context of the study and the contribution they could provide. 4 companies agreed to be involved. As for the acquisition of information, we performed a series of semi-structured interviews with the managers of the selected companies. Thus, we ensured that the interviewees were qualified to answer the questions knowledgeably. We recorded and transcribed each interview. The interviews lasted approximately 60 minutes each. We structured the interviews into three parts. An introductory part to collect information on the company, products, and activities. A second part aimed at identifying the digital technologies used by the firms and understanding their role in business activities, and a final part to focus the analysis on the interplay between technology adoption and individuals' responses.

As for data analysis, we first examined each case individually, transcribing the interviews and performing a coding activity. Following Hsieh & Shannon (2005) classification, we used a directed coding methodology. This is particularly indicated to test and expand existing theory, and thus perfectly fits the research goals.

According to this methodology, coding begins by associating to relevant text passages variables derived from the literature review. In the second phase, the relevant passages not yet categorized are associated with new categories, to expand existing theory. This is an iterative process that continues until unique and exhaustive categories are identified. The main weakness of this coding approach lies in favouring bias caused by the analysis of the pre-existing literature. To guarantee the trustworthiness and transparency of the results, three researchers independently coded the text and then collaborated to define the final categories. Furthermore, to strengthen the analysis we resorted to information triangulation (Ebneyamini & Sadeghi Moghadam, 2018; O'Brien et al., 2014). Specifically, we

asked the respondents to review our categorization to confirm or enrich the analysis. Finally, we compared the information provided by each company, to clearly distinguish between common elements and unique considerations.

3.1 Results – case description

All the selected companies grow grapes, produce, bottle, and label the wine internally. All companies are SMEs, producing between 18.000 and 150.000 bottles a year. No company sells directly to final consumers or companies in the Ho.Re.Ca. industry. Instead, companies rely on trusted third parties for the distribution and marketing of their products. All companies produce high-end wines, which are sold both in Italy and abroad, especially in China and the United States.

As for the organizational structure, firms have a workforce ranging from 8 to 30 employees. To perform key field and production operations, companies hire up to 150 temporary workers in specific periods of the year. Among the permanent employees are the managers. Owners act as general managers defining the firm's strategy and value proposition. All firms have at least one operations manager, who supervises workers and production processes, and a sales manager, who manages sales channels and interactions with third parties.

As for digital technologies, all firms use third-party software to enhance product management and streamline workflows. These are cloud services and allow companies to integrate information regarding stored products, product batches, shipments, and customer databases. Additionally, all companies have a website to promote and sell products online and to receive external communications and feedback. Among the selected cases, only one company uses an advanced telemetry system operated by a third party, to obtain real-time data useful to monitor the condition of the vines and support the execution of field operations, such as seeding or fertilization.

Synthesizing, companies in the wine supply chain use mostly basic digital technologies common to most of the firms operating in the industry. This was also pointed out by one of the managers, who stated "*Any competitive company that operates in this sector now uses software for warehouse management and product traceability*". Only one of the companies uses advanced technologies, and a key element is the collaboration with an external provider. One of the

interviewees stated: *"The technology is theirs (of the provider), we only use it, but they are the ones who manage the devices and ensure that it works"*.

4 Discussion

Moving on to the analysis of the individual-level factors influencing companies' digitalization, we start by considering the key role of management. Confirming previous results, we observe that the support of top management is a key element to foster the digital transformation of companies. In all the cases we analysed the driving force behind companies' digitalization efforts was the choices of the owners. As one of the interviewees stated: *"Management has pushed hard in recent years for the adoption of digital technologies because they are essential in the industry today"*.

Regarding the way companies implement their digitalization strategy, our analyses suggest that in addition to cost assessments, two other crucial individual-level factors require consideration.

On the one hand, a central theme is the management and development of digital skills. Owners rarely possess the knowledge to identify and select the most advanced and suitable solutions. Therefore, to support business innovation, the management hired new staff. Interestingly, the new figures possess mainly transversal skills which do not focus specifically on digital knowledge. All companies hired operations and sales managers, who consider digital technologies mainly as communication and coordination tools. As one of the managers we interviewed said *"Digital technologies are now essential to synchronize work, and to manage and track the products"*. Furthermore, one of the managers stated that: *"The company would find it especially difficult to hire a technological specialist, both because of the costs entailed, and because at this moment we do not feel such a need"*.

Moving from these results, we highlight a key relationship between companies' digitalization and individual-level factors. SMEs' owners are aware of the importance of digital technologies for business development. At the same time, the lack of resources prevents companies from hiring specialized staff. This causes a lack of high digital knowledge which, in turn, makes it difficult for companies to understand and leverage the full potential of innovative technologies. One of the ways for SMEs to solve this issue is by collaborating with external partners. Indeed, the only company that adopted an advanced telemetry system did so by

delegating the installation and management of the system to an external provider. Moreover, the managerial software used by the other companies is also provided by third parties. Ultimately, considering the limited resources available to SMEs, which prevents them from investing directly in the acquisition and development of employees' digital skills, we argue that collaboration with external partners could allow them to adopt innovative solutions while enhancing their knowledge and gradually accustoming employees to digital technologies.

A second fundamental element in explaining the relationship between the adoption of digital technologies and human responses in SMEs is the organizational culture. Again, top management plays a key role. Given the relatively small number of employees and the prevalence of direct communication mechanisms between top levels and the staff, management can exert a significant influence on the culture of the organization (Eller et al., 2020; Werner et al., 2018). As previously mentioned, in the cases we analysed the companies convincedly embraced the innovations mainly because the management considered them an essential element for the success of the company. In this regard, we stress that, just as management intervention can foster the adoption of innovative technologies, it can also represent a major obstacle. Specifically, we observe that none of the companies uses advanced technologies in the wine production processes. Available solutions could effectively support such activities, elaborating real-time data to monitor the status and progress of processes. For example, IoT systems could be used in combination with smart sensors to monitor the temperature and condition of the wort during fermentation. Or they could be used to assess the condition of the wine during ageing (Costa et al., 2013; Ruiz-Garcia et al., 2009). Despite this, and regardless of economic assessments, none of the companies is willing to consider the introduction of these technologies. We argue that one of the main reasons is to be found in individual cultural resistances, fuelled by management influence.

Indeed, as one of the interviewees stated: *"The owner is an internationally renowned winemaker who cares a lot about the quality of the product. Therefore, we do not use any technology in the production processes, because it is important for us to maintain the authenticity of the product unaltered"*. Furthermore, individual-level resistance can also appear as scepticism about the potential of technology. From this perspective, we observe that cultural resistance can be deeply connected to the lack of advanced digital knowledge. One of the interviewees stated: *"In my opinion, some operations, such as the dosage of*

sulphites or the fermentation must be carried out in the traditional way, which is the real keystone of the company"".

Furthermore, organizational culture and inadequacy of digital skills also affect the response of employees to the digitalization of companies. As pointed out by one of the interviewees *"Right now it is difficult to imagine introducing very advanced technologies on the production or warehouse side because there is a core of employees who are used to working in a certain way... and the introduction of these tools would slow down a process and change mechanisms that are currently perfectly functional"*. Furthermore, this would require *"training, hiring... and we don't feel the need to do it at the moment"*.

Ultimately, our analyses provide evidence that individual-level factors play a fundamental role in the digitization of SMEs. Supporting and moving beyond literature results, we argue that to promote an effective and sustainable digitalization process for SMEs it is essential to consider the influence and the relationship between top management support, culture, and individual digital skills.

5 Conclusion

In this work, we analysed how individual-level factors affect SMEs' digitalization. In designing our work, we moved from the observation that the literature lacks works analysing the interplay between companies' digitalization and individual responses. To help bridge this gap, we first performed a thorough literature review aimed at identifying the main individual-level factors affecting SMEs' digitalization efforts. Results point to four categories of factors, namely digital skills, skills and competencies, culture, and top management support.

To support previous results and enrich the debate with new elements, we used a rigorous case study methodology to investigate how individual-level factors affect the digitalization of Italian SMEs in the wine industry. We chose to focus on the wine industry since previous literature suggests it is a sector with great opportunities, but also strong obstacles to digitalisation. Furthermore, aiming to provide a comprehensive analysis of the current situation and lay the foundations for future theory development, we tried to select representative cases of the digitization of SMEs in the wine industry. Thus, we focused our investigation on the elements common to the selected cases. Moving beyond literature results, we argue that SMEs' digitalization is influenced by two interconnected elements.

On the one hand, there are individual-level factors, which mainly concern management support, digital skills and employees' culture. Analysing the case studies, we found evidence that each of these factors can significantly favour or, conversely, hinder the digital transformation of SMEs. We also highlighted the relationships between these elements and observed that in SMEs the main tool for promoting the adoption of digital technologies is direct communication between management and employees, rather than the use of formal control and reward systems. We also observed that one of the main tools SMEs can leverage to enhance their digital transformation is the collaboration with trusted third parties, who could provide the necessary technologies and skills, without requiring direct investments by the SMEs.

On the other hand, SMEs' digitalization efforts are frustrated by the lack of resources. This not only limits the ability of small businesses to acquire new technologies but also makes it difficult to develop advanced digital skills while fuelling employees' scepticism towards innovative technologies.

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Expanding the Tragedy of the Commons Archetype: A Systems Thinking Reflection

Francesca Ricciardi

Department of Management
University of Turin
C.so Unione Sovietica, 218/bis, 10134, Turin, Italy

Canio Forliano*

Department of Management
University of Turin
C.so Unione Sovietica, 218/bis, 10134, Turin, Italy

Alberto Bertello

Department of Management
University of Turin
C.so Unione Sovietica, 218/bis, 10134, Turin, Italy

Stefano Armenia

Università Telematica degli Studi IUL
Via Buonarroti 10, 50122, Firenze, Italy

Paola De Bernardi

Department of Management
University of Turin
C.so Unione Sovietica, 218/bis, 10134, Turin, Italy

* *Corresponding author*

Abstract

The paper "The Tragedy of the Commons" by Hardin in 1968 highlighted the potential depletion of shared resources due to the self-interested behavior of individuals. This study sparked interest in scholars to understand how individuals make sense of shared resources and how to prevent over-exploitation. Elinor Ostrom challenged the assumption of the rational actor and showed that communities could self-organize and develop effective institutional arrangements to protect shared resources. She introduced systems thinking to understand the interactions between common resources and the broader system of socio-

material practices. This conceptual study aims to integrate the failure to refrain and act perspectives by developing a qualitative system dynamics model that expands the tragedy of the commons archetype. Systems archetypes are generalized patterns of behavior that abstract the underlying structure of complex systems. The study aims to discover and summarize archetypical patterns and factors that contribute to their emergence. This approach contributes to the common goods theory and systems thinking literature streams while offering a practical tool for policymakers to see trends and choose effective actions to enhance and regulate the system. Indeed, studying underlying patterns in the behavior of systems helps to distinguish between successful and ineffective actions.

Keywords – common goods, systems thinking, system archetype, sense-making

Paper type – Academic Research Paper

1 Introduction

In 1968, Hardin's seminal paper "The Tragedy of the Commons" was published in Science (Hardin, 1968). This study understands the commons simply as shared, exhaustible resources, such as a village's grazing lands. Based on classical homo economicus assumptions, which see humans as rationale and self-interested agents, Hardin argues that when a commons is at stake, even if the negative consequences of over-exploitation are crystal clear, people likely assume that the other users of the shared resource will not refrain themselves from over-exploiting it. For this reason, Hardin predicts that, when put in the condition to draw from a commons, most users will adopt the "get it while you can" strategy, and then the commons will be doomed to depletion. Hardin's reflection has attracted the attention of several scholars to understand how people's individual and collective sensemaking processes (e.g., Adams et al., 2003; Folke et al., 2005) can be governed to develop a shared understanding and knowledge while preventing the overexploitation of resources with low levels of excludability (i.e., it is difficult to prevent people from using such resources) and high levels of rivalry (i.e., resource exploitation by one individual hinders simultaneous exploitation by other individuals).

A famous response to these perspectives comes from Elinor Ostrom, who provides a new way to tame the free-rider problem or social dilemma. Her studies showed that, in order to prevent the tragedy of the commons, it is not necessary that the resource is privatized or that the State imposes and enforces rules to protect the common pool resource (Ostrom, 1990). Ostrom investigated how, in

many real-world cases, the community of users self-organized and developed ad-hoc, effective institutional arrangements to protect their common-pool resource from over-exploitation (Dietz et al., 2003). These results suggest that the rational actor assumption should be replaced by a much more complex understanding of the human being as, first of all, a social being (see, for example, Sigmund et al., 2010). Ostrom, and a viable research community around and after her, investigated the factors that enable the community of users of a certain common pool resource to successfully self-organize and develop local institutional arrangements that avert the tragedy of the commons. In her last years, Ostrom strongly contributed to introducing systems thinking in the studies on the commons (Ostrom, 2009). She clearly distinguished the common pool resources (in terms of stocks and flows) from the underlying processes of the system that may protect or (re)generate them. Hence, while in Hardin's conceptualization the tragedy of the commons was occurring mainly when people fail to refrain from resources' misuse or profiteering behaviors, Ostrom's broadened the perspective to the recursive interactions occurring between common resources and the broader system of activities and complexes of processes embedded in socio-material practices.

Drawing on this perspective, we develop a qualitative system dynamics model that aims to move one step forward by analyzing the virtuous and vicious loops activated by the complex system of cognitive, social, and organizational dynamics at stake in commons governance. Inspired by sensemaking literature, we develop a model that illustrates how actors make sense of the tragedy of the commons. In a world in which the socio-ecological equilibrium of many ecosystems is threatened by human carelessness and misappropriation, and in which technological advancements (such as Wikipedia years ago and ChatGPT nowadays) disrupt the way we pool knowledge, it is of the utmost importance to understand how humans behave to protect shared resources. The complexity, uncertainty, and value-laden character of the societal challenges we face (see Ferraro et al., 2015) increase the variety of possible plausible responses. So what happens when the commons we are expected to protect and (re)generate are not only forests, grazing lands, fisheries, but also knowledge commons, digital commons, urban commons, health commons, and cultural commons? What happens when environmental complexity creates more complex sensemaking systems?

2 Conceptual background: the tragedy of the commons archetype

To help visualize the dynamics related to the tragedy of the commons as unveiled in Hardin's conceptualization, in system dynamics scholars have usually referred to the "Tragedy of the Commons" archetype (Senge, 1990). System dynamics (Forrester, 1994) is indeed a field of study that seeks to understand the behavior of complex systems over time, as well as the underlying causal structures that characterize them (Richardson, 2011). Grounded in systems thinking (Meadows, 2008), one important aspect of system dynamics is the identification and analysis of archetypes, recurring patterns of behavior that describe the dynamic causal relationships between different variables within a system. In a never-ending chain of cause-and-effect relationships, every occurrence leads to another event. Hence, digging down to the systemic structure of complex phenomena is critical to understand the world as patterns of behavior across time. Accordingly, this kind of analysis is fundamental to unveiling the root cause of an issue rather than only its symptoms (Sterman, 2002). At the same time, it helps to understand what motivates the behaviors one can witness, identify possible leverage points to intervene (Meadows, 1999), and then take steps to achieve the expected outcomes, altering a system's structure or behavior. The systems approach may help us rethink existing issues from a fundamentally new viewpoint, which can help shed light on them. Traced in the form of causal loop diagrams, the ten identified systems archetypes (Senge, 1990) depict dynamic events that often recur in generalizable contexts and thus represent effective tools for diagnosing issues and locating highly effective leverage points.

Adapted from Kim (1992), Figure 1 shows a causal loop diagram of the tragedy of the commons archetype. Both actors A and B engage in actions like introducing animals to the pasture, and both players profit financially from their efforts. So, for example, A's activity led to an increase in the net gains for A, which further motivates A to increase his/her activity. In this sense, the positive link between the two variables "A's activity" and "Net gains for A" describes a direct causal relationship between them. If the cause increases or decreases, the effect will increase or decrease accordingly. The interaction between them depicts a self-reinforcing feedback loop (called R1), which can be associated with the system's exponential growth or decay behavior. Similarly, the net gain earned by B as a consequence of his/her activity is depicted by R2, the second self-reinforcing feedback loop of the model. Despite an increase in overall activity,

there is little to no productivity loss since they are not yet at the resource's maximum capacity and there is little to no impact on "gain/individual activity."

When the overall activity grows too much, actors A and B must eventually make a choice, since productivity declines as they get near the resource limit or its regeneration capacity. If they do what is "best for all concerned," then self-balancing loops B1 and B2 should prevail and activity should cycle down to a tolerable level. In any case, it takes some time to recognize that an increase of the system's level of activity impacts the individual benefits of the two actors and adjust their actions. As a result, the tragedy of the commons archetype describes a situation in which a shared resource is subject to overuse or depletion due to the self-interested behavior of individuals or groups. The term "commons" refers to a resource held in common by a group of people, such as a pasture, forest, or fishery. In the absence of regulation or restrictions (dominance of the self-balancing feedback loops), individuals or groups may have an incentive to exploit the resource for their own benefit, even if this leads to overuse or depletion of the resource over time (dominance of the self-reinforcing feedback loops).

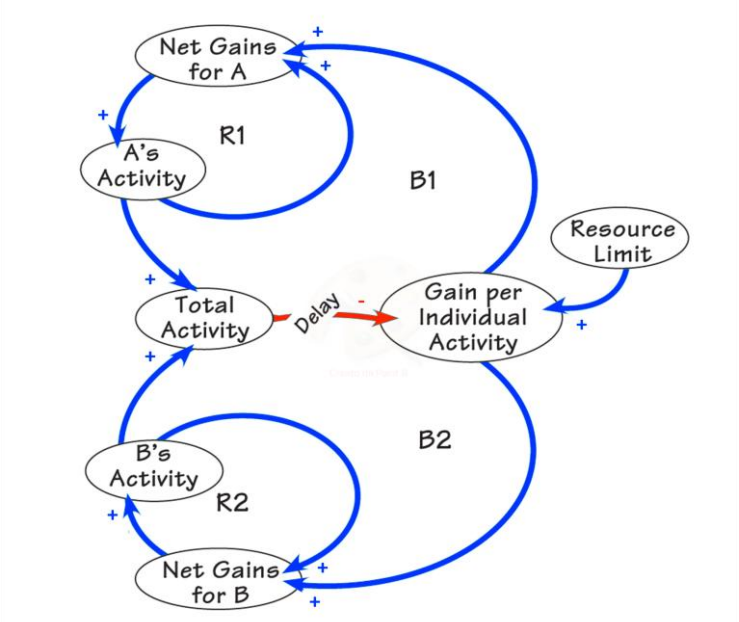

Figure 1. The tragedy of the commons archetype.
Source: adapted from Kim (1992).

3 A first expansion of the the tragedy of the commons archetype

Following the above-mentioned arguments, Hardin (1968) came to the conclusion that the commons need to be either privatized (free market) or maintained as public property where access and usage rights must be distributed and regulated. In some cases, privatizing the resource in question can help ensure that it is used in a more sustainable and equitable way. For example, suppose a pasture is held in common by a group of farmers. In that case, each farmer may have the incentive to graze as many animals as possible to maximize their profits. Differently, if the pasture is divided into individual plots and each farmer is given the exclusive right to graze on their own plot, they may have an incentive to maintain the quality of the pasture and ensure that it is not overgrazed. However, the creation of property rights is not always a practical or desirable solution. In some cases, the resource in question may be difficult to divide or privatize, or there may be cultural or historical reasons why it is held in common. Additionally, privatization may lead to unequal distribution of resources, with those who have more wealth or power able to acquire the most valuable resources. In these cases, the intervention of the regulators and the commons kept as public property should be preferred.

Furthermore, the original archetype does not consider that humans do not often act as globally rational actors but usually make judgments in light of their limited knowledge about the system they are part of (Garrity, 2012). In essence, if they lack input on the condition of the shared resource or the actions of the other users, they would make decisions based on their bounded rationality. So, supposing that they perceive the common resources and, consequently, their individual gain are depleted by the increase of the total activity toward the system's carrying capacity or desired level. By acting rationally, they could decide to contribute to the system but support only a part of the costs. As a result, they would increase their level of activity and, so, contribute to the whole system's activity. This would activate two additional self-reinforcing feedback loops, called R3 and R4 in Figure 2, further leading to the common resource depletion.

In this first expansion of the model, we also highlight that we decided to change the variable "resource limit" to "desired level". In fact, talking of a desired level helps make the model generalizable to systems where commons have an intrinsic regenerative capacity, with limits adjustable over time towards a desired level. Similarly, we believe this change helps better adapt the model to unveil the

dynamics characterizing not only commons that one would like to maximize but also to control or limit. One example of this latter perspective could be related to the stock of emissions in the air, which represents a common resource whose level should be minimized but could hardly be imagined in terms of a limited resource to be consumed or used.

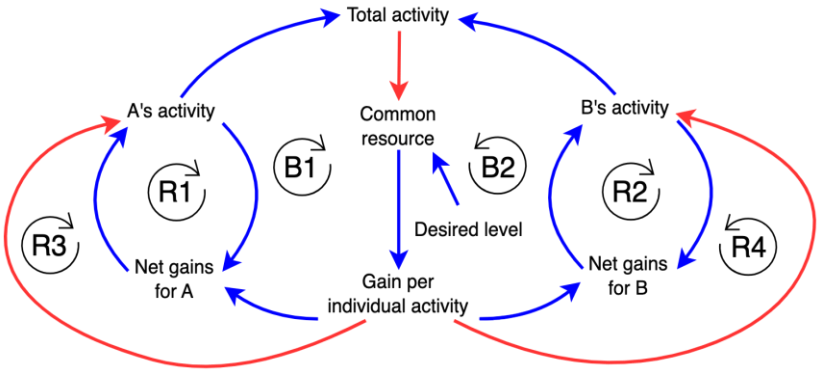

Figure 2. A first expansion of the tragedy of the commons archetype. Source: adapted from Garrity (2012).

4 Adding two conceptual levels of analysis

Further expanding the archetypal model, in Figure 3 we linked what happens at the material level of analysis to the individual and collective sensemaking processes and responses to the tragedy of the commons. Hence, feedback systems that measure the common resource's level can activate people's individual and collective sensemaking processes (e.g., Adams et al., 2003; Folke et al., 2005). This would result in a shared understanding and knowledge that a tragedy of the commons is likely to happen. The problem arises when the benefits of exploiting the resource are immediate and personal, while the costs of overuse are shared among all users, leading to a situation where no single individual or group has an incentive to conserve the resource for future use.

People may thus perceive that preserving the commons requires the contribution of other individuals who could decide not to give their contribution but rather abandon the commons. On a collective level, this issue is related to what is usually called social loafing (e.g., Simms & Nichols, 2014), namely the perception of high efforts that reduce people's motivation to work. As a result, they may be less willing to contribute to the commons, increase the common

resource and, so, the sensemaking process related to the occurring tragedy of the commons (R5). Furthermore, the more people reduce their self-organized work, the more they will reduce their perception of future stranding (B3), having abandoned the commons.

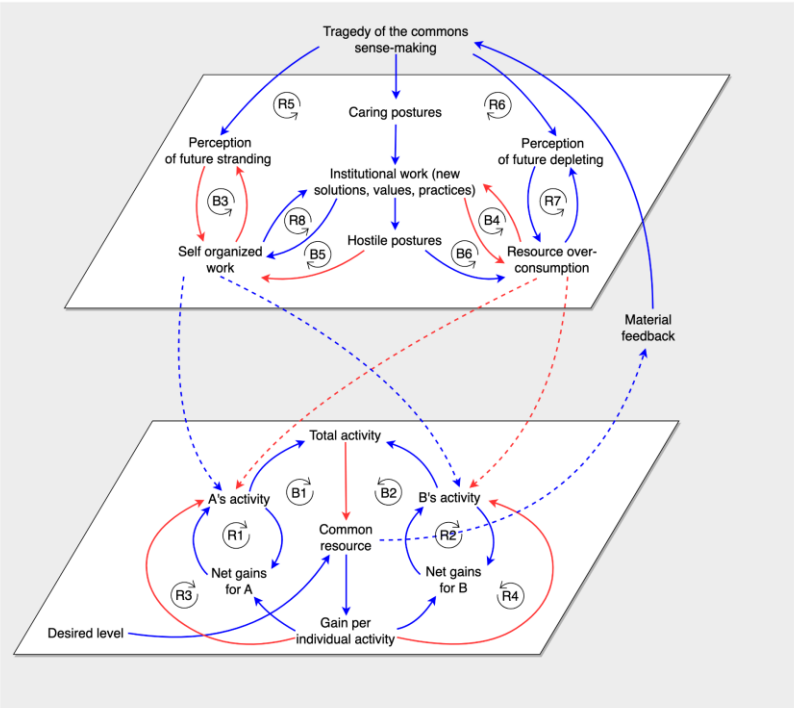

Figure 3. A complete overview of the expanded tragedy of the commons archetype. Source: Authors' own elaboration

On the other side of the model, when sensemaking processes are activated, if people perceive that the likelihood of the resource being depleted is high, they may be more willing to exploit the resource for their own benefit. Conversely, if they perceive that the likelihood of depletion is low, they may be more willing to refrain from using the resource to conserve it for future use and preserve collective benefit.

However, considering the first case, not refraining from resource overuse ultimately harms everyone in the long run, reducing individuals' activity. This increases the common resource's level, additionally leading to a high perception of future depletion (R6). Similarly, the more people overuse the resource, the

more they will perceive that others will do the same, further depleting the commons. This describes the self-reinforcing feedback loop R7.

In the end, to address the tragedy of the commons, it is important to develop collective norms and frameworks that encourage sustainable use of shared resources, as well as individual and collective awareness of the long-term consequences of possible social loafing or resource overuse behaviors. So, if people nurture caring postures toward the commons, they will practice institutional work resulting in new shared values, practices, and behaviors. This, on the one hand will increase individuals' willingness to contribute to the commons (R8), while on the other hand will reduce their willingness to overuse the resource (B4). However, not everyone is likely to adhere to this new set of shared solutions and practices and someone could mature hostile postures toward the commons. By doing so, they could reactivate the social loafing or resource overuse feedback loops by decreasing the amount of self-organized work (B5) or increasing resource overconsumption (B6).

5 Conclusions

The paper "The Tragedy of the Commons" by Hardin in 1968 is a seminal work that highlighted the potential depletion of shared resources due to the self-interested behavior of individuals. Hardin argued that shared resources such as land, air, and water could be over-exploited if individuals acted solely in their own self-interest. Hardin's work sparked interest among scholars to understand how individuals make sense of shared resources and how to prevent over-exploitation.

Elinor Ostrom challenged the assumption of the rational actor, which assumes that individuals act solely in their own self-interest, and showed that communities could self-organize and develop effective institutional arrangements to protect shared resources. She introduced systems thinking to understand the interactions between common resources and the broader system of socio-material practices. Systems thinking involves understanding the complex relationships between the different components of a system, and how changes in one component can impact the entire system. Ostrom's work showed that individuals could work together to manage shared resources in a sustainable way. She identified several design principles for successful common-pool resource management, including clearly defined boundaries, rules that are adapted to local conditions, participation by those affected by the rules, and mechanisms for monitoring and

enforcing compliance. Ostrom's work challenged the conventional wisdom that only centralized government control or private ownership could prevent the tragedy of the commons.

Researchers have developed a range of conceptual models to understand how individuals interact with shared resources. One such model is the tragedy of the commons archetype, which, however, mainly captured the dynamics related to a resource over-exploitation as conceptualized by Hardin. This archetype represents a situation in which multiple individuals have access to a common pool resource, and each individual can choose to either refrain from using the resource or use it to their advantage. If everyone acts in their own self-interest, the resource will eventually become depleted, leading to a tragedy for all.

To address this problem, researchers have developed various policy interventions, including the use of regulations, taxes, and incentives to encourage individuals to conserve the resource. However, the effectiveness of these interventions depends on the underlying patterns of behavior that drive individuals' decision-making.

To better understand these patterns, in this study we turned to systems thinking and systems dynamics modeling. Systems dynamics modeling involves developing qualitative or quantitative models that represent the underlying structure of a system and the relationships between its components. By understanding the dynamics of the system, decisionmakers can choose interventions that are more likely to be effective. So, this conceptual study aimed to integrate the failure to refrain and act perspectives, as well as a third way related to the possibilities opened by caring postures and institutional work to mitigate those issues, by developing a qualitative system dynamics model that expands the tragedy of the commons archetype. By doing so, this study contributes to both the common goods literature and system thinking literature by discovering and summarizing archetypical patterns and factors that contribute to their emergence. Besides contributing to those literature streams, in this work we offer a conceptual tool for policy and decisionmakers to see trends and choose effective actions to enhance and regulate systems in which a common good is involved. Indeed, studying underlying patterns in the behavior of systems helps to distinguish between successful and ineffective actions.

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From Daughter Successor in the Family's Firm to Starting One's Own Enterprise: A Case Study in the Jewellery Sector

Annalisa Sentuti*

University of Urbino Carlo Bo
Via Saffi 42, Urbino, Italy

Francesca Maria Cesaroni

University of Urbino Carlo Bo
Via Saffi 42, Urbino, Italy

* *Corresponding author*

Abstract

Research has deeply investigated factors that may hinder or favour the possibility of daughters being chosen as successors in family businesses. Little is known, however, about daughters who voluntarily decide to leave the family business, despite the possibility of serving in the leadership role, to engage their entrepreneurial aptitude and potential in creating new enterprises.

This paper investigates the experiences of a successor daughter who decided to give up that role to start her own entrepreneurial venture. Placing in the research field of family entrepreneurship and drawing on the case study method, we identified the motivations behind her decision and how her entrepreneurial identity was formed in this context. Special attention was given to the role of the entrepreneurial family to understand how it may have influenced the daughter's choices and her identity construction process.

We show that the entrepreneurial family can play a decisive role in three different stages of a daughter's identity formation process, i.e. when: 1) the idea of starting one's own business emerges and takes shape; 2) the decision to pursue an independent entrepreneurial career is made; and 3) the new entrepreneurial activity is launched.

Keywords – Family firms, Entrepreneurial families, Successor daughters, Women entrepreneurs, Jewellery

Paper type – Academic Research Paper

1 Introduction

This paper aims to investigate the reasons that may lead a daughter designated as a successor in the leadership role of her family business to decide to give up that role and leave the family business to start her own entrepreneurial venture. The results offer interesting insights into a topic that has not been investigated so far in the literature on daughters in family businesses. In fact, this research field has mostly investigated factors that may hinder or favour the possibility of daughters being selected as successors for the leadership role in the family business. In contrast, the experiences of daughters who voluntarily decide to leave the family business despite the possibility of serving in the leadership role have not been investigated. However, some scholars have recently observed that taking over the family business is not the only option available to daughters to express their entrepreneurial aptitude daughters may have formed within their family entrepreneurial context. Daughters could also express their entrepreneurial potential outside the family business, i.e., through the creation of new ventures.

This paper addresses this issue by analysing the experience of a daughter who decided to leave her family's business after working there for a number of years with a major managerial role. The objective of the investigation is twofold. First, it aims to identify the reasons behind this daughter's decision and, second, to understand how her experience in the family business may have contributed to the formation of her daughter's entrepreneurial identity, to the extent that it prompted her to start a new business venture outside the family business. Specifically, the analysis aims to answer the following research questions:

> *(RQ1) What motivates a successor daughter to give up the leadership of her family business to start her own entrepreneurial venture?*
>
> *(RQ2) How is her entrepreneurial identity formed in this context?*

To answer these research questions, we place our analysis in the research field of family entrepreneurship (Bettinelli et al., 2014; Randerson et al., 2015, 2021) and adopt an inductive approach base on a case study.

This analysis shows that the family can play a decisive role in a daughter's entrepreneurial identity formation. This role can manifest itself in three distinct stages of this process, i.e. when: 1) the idea of starting one's own business emerges and takes shape; 2) the decision to pursue an independent entrepreneurial career is made; and 3) the new entrepreneurial activity is launched.

The remainder of the paper is structured as follows. First, we highlight the theoretical background of the paper. We then set out the method employed and empirical focus of our study. The findings are then presented, followed by the discussion and conclusions.

2 Theoretical Background

Family entrepreneurship (Randerson et al., 2015) is an emerging field of research that stems from the intersection of three systems – family, business, and entrepreneurship. It aims to deepen our knowledge of the entrepreneurial behaviour of individuals, families, and family-owned businesses and how they can shape and influence each other (Randerson et al., 2021). While investigations about mutual influence relationships between business and family have been widely investigated (Estrada-Robles et al., 2021), less is known about how individual entrepreneurial processes can unfold within family and family business contexts (Randerson et al., 2021).

Although it is widely recognized that entrepreneurial families, i.e. families that own one or more businesses and pursuit entrepreneurial activities across generations (Capolupo et al., 2022), can stimulate an entrepreneurial attitude and behaviour in their members by exposing children to entrepreneurial role models (Zellweger et al., 2011), passing on skills, knowledge, career opportunities (Rogoff and Heck 2003; Bettinelli et al., 2014; Randerson et al., 2015), and providing social, financial and human capital (Estrada-Robles et al., 2021), we have little knowledge about motives, factors and conditions that may prompt children to pursue entrepreneurial careers outside family businesses. Most studies have investigated how entrepreneurial families can feed new generations' entrepreneurial attitude and motivate designated successors to ensure the viability of family businesses and their survival over time (Habbershon et al., 2010; Eddleston et al., 2012; Zellweger and Sieger, 2012; Michael-Tsabari et al., 2014; Zellweger et al., 2012; Canovi et al., 2022). Conversely, few scholars have focused on nonsuccessors and their entrepreneurial choices. For example, Combs et al. (2021) note that the entrepreneurial legacy that entrepreneurial families transmit to younger generations should extend beyond the successors. While designated successors feel the responsibility of having to ensure the continuity of the family business, nonsuccessors can have a greater range of choices and decide more freely whether and how to exploit the entrepreneurial legacy they have received from

the family. These authors also observe that most nonsuccessor adult children decide not to pursue an entrepreneurial career, while those who do may choose to start a business related to the family's firm portfolio or, conversely, to start a new venture in a completely different sector from that of the family context. Furthermore, the authors find that nonsuccessor daughters have fewer chances to engage in external entrepreneurial paths because of lacking emotional, business, and financial support from their families to start their own businesses. Since this phenomenon remains largely unexplored, Combs et al. (2021) call for further research to learn about nonsuccessor women's entrepreneurial careers "by listening to their unique narratives" and considering the role of family (p. 23).

The topic of daughters in family businesses has been mainly investigated looking at the reasons that may favour or, more often, hinder the possibility of being designated as successors for family business leadership.

Many investigations have also been done on daughters excluded from succession (Sentuti et al., 2019). In contrast, the case of daughters who prefer to start their own business despite the opportunity to take over the reins of the family business previously led by their parents has never been investigated.

Therefore, exploring what motivations may lead designated successor daughters to leave their family business to start a new business could be very captivating.

This paper contributes to fill this gap by investigating the case of a daughter who was designated as successors but decided to leave the family business leadership role and exert their entrepreneurial spirit in creating a new enterprise. For the reasons described above, this case has unique features that make it particularly interesting for understanding how the family context can help nurture and shape a daughter's entrepreneurial identity.

The latter refers to how entrepreneurs define themselves by answering the question "Who am I?" and relates to the meanings and behaviours associated with the entrepreneurial role (Murnieks et al., 2014; Radu-Lefebvre et al., 2021). Entrepreneurial identity is considered a key concept for understanding entrepreneurship (Mmbaga et al., 2020; Navis and Glynn, 2011) and is deeply investigated in the flourishing research about how daughters form their identity as successor in family business (Bettinelli et al., 2022; Bjursell & Melin, 2011; Fernandes & Mota-Ribeiro, 2017; Hytti et al., 2017; McAdam et al., 2021; Mussolino et al., 2019; Sentuti et al., 2023). An under-explored element of this debate is the experiences of daughters who decide to abdicate the role of

successor and set up a new venture outside the family businesses. We believe that this experience deserves to be considered also to account the heterogeneity that characterises the experience of women entrepreneurs.

3 Methodology

To answer our research questions, a qualitative approach based on the case study method has been adopted. A single case study (Yin, 2003; Eisenhardt and Graebner, 2007; Miles et al., 2014) suitable for the aim of the research was chosen by the authors. In single-case research design, cases are chosen because they are unusually revelatory (Yin, 2003), help the researchers richly describe a phenomenon (Siggelkow, 2007), allow the investigation of a "transparently observable" phenomenon (Eisenhardt, 1989, p. 537) to gain new theoretical insights (Eisenhardt and Graebner, 2007).

The case was selected as part of a broader research aimed at investigating how nonsuccessor daughters who start their own businesses form their entrepreneurial identity (Sentuti and Cesaroni, 2021). The analysis revealed that some daughters decide to start a new venture and pursue their own entrepreneurial career after a few years of experience as family business leader. The most information-rich case among those belonging to this last group was selected. It allows one to "learn a great deal about issues of central importance to the purpose of the research" (Patton, 1990, p. 169). Specifically, the experience of Carlotta (fictitious name), a 37-year-old entrepreneur, was analysed. She has been designated as the successor to her family's business, which has more than 500 employees and operates in the furniture and design industry. After some years of experience in the family business with managerial roles (mainly in marketing), she decided to leave the family's business and started a new venture, now a Made in Italy small business emblem in the jewellery sector.

Both primary and secondary data has been collected. A direct interview is the primary source of data, supplemented with interviews from the press, social network profiles, blogs, and the websites of the family business and the company founded by the entrepreneur.

Data analysis was conducted by adopting an inductive and interpretative approach based on hand coding and following the Gioia method (Corley and Gioia, 2004; Gioia et al., 2013). This analysis made it possible to reconstruct the process of constructing Carlotta's entrepreneurial identity and understand the

family's role during this process. The results are illustrated below, making extensive use of quotes extracted from the interview.

4 Case analysis

Data analysis allowed us to highlight the daughter's motivations underpinning the choice to leave the leadership of the family business and start a new venture and outline her entrepreneurial identity process of formation. This process can be broken down into three main stages, and motivations emerge in the first one. Namely, each step is characterized by a series of factors, represented by conditions, perceptions, interpersonal dynamics between family members, and relationships between the daughter and family business. These contributed to determining the reasons that initiated the process of forming the analysed daughter's entrepreneurial identity, how this process developed, and its final effect. These stages, along with factors characterizing them, are described and discussed below using excerpts from the interview.

Stage 1 – The idea of starting one's own business emerges and takes shape

This phase refers to the context in which the idea of exiting the family business, renouncing the leadership role in this company and starting an independent entrepreneurial activity gradually took shape.

Carlotta is a brilliant marketing graduate. After a significant experience in a well-known multinational company, she decided to join the family business (a large company in the building sector) when her father began to suffer health problems: "*There was a problem with my father's health that led me to bring forward my return to the company. I say anticipate because I'm sure I wanted to try anyway*." Her father gave her '*carte blanche*' and Carlotta set up the marketing department with great satisfaction and over time introduced important management innovations: "*When I joined the family business my father immediately gave me a great deal of space, he told me 'Come here and help me restructure everything […] 'make yourself at home, because you are at home'. And so I started creating the marketing department.*"

A path of growth within the family business started, which soon led Carlotta to become her father's right-hand woman and designated successor. Nevertheless, Carlotta felt ambivalent emotions. On the one hand, she was delighted with her job: "*I always felt very, very free to run the company as I thought was right, of*

course always confronting my staff depending on the issues. I felt very fortunate, I didn't experience the succession that can sometimes occur, where you feel chained and can't do anything. No, I felt very welcome and free in the family business."

On the other hand, she perceived a certain uneasiness, an underlying tension between her role as successor and her values and true ambition: "*The family business is a very large and complex business to manage, requiring a lot of time and energy. Let's start with an assumption: in my opinion it is not true that men and women in the world of entrepreneurship can do the same things, especially if a woman decides to have children and wants to follow them. At least in my experience that's the case*." And she added: "*Such a demanding work is not part of my being [...] I wanted to do something of my own that would give me satisfaction without taking up all my time, i.e. that would also allow me to follow my family. Why else would one have children*?"

It is in this context that the Carlotta's idea of "doing something else" began to take shape: "*I never imagined myself as a self-employed entrepreneur, to tell the truth [...] but over time I start to think to give space, to give voice to another side of me that I recognise myself in, the one that is a little more creative, sparkling and also enterprising*". For Carlotta the choice to pursue an independent entrepreneurial career was dictated by entirely personal motivations.

Stage 2. The decision to pursue an independent entrepreneurial career is made

The decision to leave the family business leadership and start her own business gradually took hold in Carlotta's mind. She had become the mother of a little girl and was about to have a second daughter. At the same time, her father's health deteriorated, and it was time to make a choice. It was a tough and challenging time for Carlotta and she was increasingly determined to look for an alternative: "*During this period, perhaps as a counterpoise, my urge to create and my desire to do marketing continued to be strong. It was summer, I was looking for some jewellery to wear to the beach but couldn't find it as I wanted it. Such a bit like that, for fun, I started to design and make jewellery myself."*

Carlotta's father transferred the ownership of the company to his daughter. She still had a managerial involvement in the family business but at the same time she started thinking more and more concretely about her new entrepreneurial activity: "*I decided to visit a jewellery fair, to see if anyone was making jewellery as I*

wanted it. I saw that in fact there was no one. The style I had in mind, and I had it very clear in my mind, was not there. So I got in touch with a company that was participating in that fair and asked it to make my jewellery. 'I make it for me', I thought. In the meantime, again, a bit for fun, I said, 'Maybe I'll create a brand' and I immediately thought of a name that would evoke a sense of freshness, of lightness, a bit like the style of the jewellery should be. Then I chose the whole brand image and did some marketing work. And so I started wearing my jewellery." Carlotta recognised "*My business and entrepreneurial education is the starting point that has allowed me to get here today. […] I have had the opportunity to interact with professionals from very different backgrounds, with hyper-creative people, and this has enriched me enormously. I still benefit from my experience in the family business.*"

Carlotta felt increasingly distanced from the logic of the family business and, by mutual agreement with her father, decided to delegate the role of CEO to an external manager: "*During the first two years [within the family business, n.d.r.] I was the mother of my first daughter: I used to leave home at 8 in the morning and come back at 8 at night, my mother raised my daughter. [...] If I had wanted to continue the company I would have had to completely sacrifice my life, my family, there would have been no room for anything else. [...] Thinking about this vision of my life, I preferred to keep the ownership of the family business, but to delegate the management to managers who were paid to do this*."

Carlotta's family business was far from desire to be very close to her family and, at the same time, to pursue an entrepreneurial career in line with her interests and passions. All the conditions were in place for Carlotta to take over the family business leadership, but she was uninterested. She did not want to give up being a mother and knew that leading the family business would be too demanding and time consuming. At the same time, she had a strong entrepreneurial attitude, a great desire to realize herself and aimed to find a way to make the most of her skills and entrepreneurial legacy. Despite the decision to leave the leadership of the family business, the family's support does not diminish "*My father was one of my biggest supporters. He understood what my vision of life was and so, together, we found a solution that would allow the company to move forward with a qualified CEO and, in the meantime, to me to guarantee myself a space*."

Stage 3 - The new entrepreneurial activity is launched

Carlotta realised that her entrepreneurial spirit was leading her to a successful business: "Gradually, people were asking for my jewellery... I could see there was interest [...] Sales started to grow and, since my spirit is that of an entrepreneur, I said 'Well, if it has grown, then I must do a proper business' and so I created the e-commerce."

It was a big change. Carlotta found the new company, implemented a marketing plan using social networks and within a bit of time the business gained a foothold.

Thanks to her own small business, which is easier to manage and more in line with her needs, Carlotta was able to find her work-family balance because "It's one thing to manage this company, with a few employees where everything is much more flexible, and quite another to manage a company with 120 agents, 70 employees, 4 subsidiaries, one of which is abroad!"

Carlotta felt fulfilled now: "My jewellery gives me great satisfaction and seeing it worn by important influencers is a response to all my effort. Clearly the style I am pursuing is a style that people like". Today Carlotta is a satisfied entrepreneur and mother and a satisfied daughter. Her choice has not affected her relationship with her father and family, who still support and remain close to her.

5 Conclusions

This paper aimed to answer the following research questions: (RQ1) What motivates a successor daughter to give up the leadership of her family business to start her own entrepreneurial venture? (RQ2) How is her entrepreneurial identity formed in this context?

With regard to the RQ1, our results show that Carlotta was greatly motivated to give up her leadership role within the family business by her desire to be an entrepreneur "in her own way", i.e. follow her genuine passion (jewellery), fulfil herself and reach a sustainable equilibrium between work, family, and personal life. Findings also highlighted that these motivations are part of a broader process of daughter's entrepreneurial identity construction, that is started with the idea of create her own business, continued with the decision to leave the family business leadership and ends with the actual launch of a new entrepreneurial activity outside the family business group. This concerns the RQ2, the question we tried to answer by examining, in particular, the entrepreneurial family's role throughout

this process. The three stages of the daughter's entrepreneurial identity construction process, along with factors characterizing them, are synthetised in Figure 1.

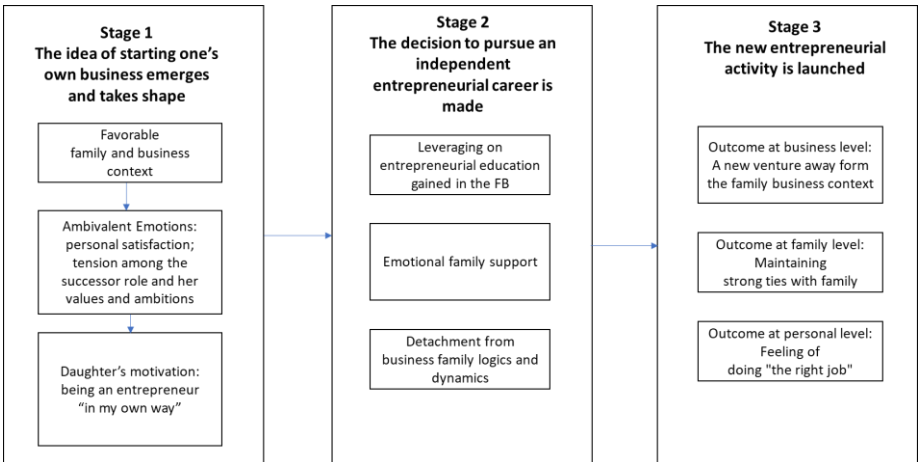

Figure 1 – How the daughter's entrepreneurial identity was formed
Source: our elaboration.

In this regard, findings show that Carlotta developed an interest in business disciplines and the family business within her entrepreneurial family. She earned a bachelor's degree in marketing, had significant professional experience in other companies, and then successfully joined her father in managing the family business. However, precisely the experience in the family business unleashed Carlotta's true entrepreneurial spirit: it triggered her desire to express a new part of herself, the more creative and vibrant one, which had been more "dormant" within the family firm. She founded a new enterprise to create an innovative vision of the jewellery concept. In doing so, she detached herself from the logic of the family business – large and complex to run – in favour of handling a new business more congenial to her. At the same time, she leveraged on her entrepreneurial education gained through her experience in the family business and she could rely on the emotional support of her family and father in particular. The launch of the new entrepreneurial activity resulted in several outcomes that, consistent with the family entrepreneurship framework, can be measured on three levels: business, family and individual level.

Along this path, Carlotta built her entrepreneurial identity through a *metamorphosis process*. She transformed herself from a "family business

successor", wholly and exclusively devoted to the family business, to an entrepreneur who create her "entrepreneurial ideal-self" selectively choosing those solutions which appear to be consistent with the "right balance", as in her words, between life and personal interests, family and work, according to her values and her being a woman entrepreneur and not just an entrepreneur.

The study undoubtedly has some limitations. The empirical research was done with a single case study of an Italian daughter entrepreneur. We recognise the need to realise multiple case studies with different daughter entrepreneurs within the same or different cultural context to investigate intergroup similarities and differences as regards personal experiences and contextual factors related to entrepreneurial families. Nevertheless, this paper contributes insights into women entrepreneurs and the entrepreneurial families' role by shedding new light on processes that can lead daughters who grew up in an entrepreneurial context to start their own businesses and how they form their entrepreneurial identity.

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Design-Driven Knowledge Management for Climate Heritage: Contemporary Tendencies and Future Perspectives for UNESCO Cultural Landscapes' Sustainable Development in a Changing Climate

Alessandro Raffa

Department of European and Mediterranean Cultures.
Architecture, Environment and Cultural Heritages
University of Basilicata
20 Lanera st., 75100 Matera (MT), Italy
FEEM-Fondazione ENI Enrico Mattei
Milan, Corso Magenta 63, 20123 Milan (MI), Italy

Abstract

The present paper summarizes recently-started research inside the UNESCO Chair on Mediterranean Cultural Landscape and Communities of Knowledge whose objective, from a theoretical and operational point of view, is to elaborate a design-oriented knowledge model for a climate-resilient management of the UNESCO site of the Sassi and the Park of the Rupestrian Churches, in order to understand and maximize the potential of 'Community of Knowledge' concept around climate adaptation's challenge. Heritage climate adaptation is a newly emerging research field which intends to reduce effects and enhance the benefits from present or potential climate change impacts through planned strategies and actions. Within Heritage studies, an interesting transdisciplinary debate is arising on the relationship between heritage and contemporary uncertainties, in particular with climate change. Heritage is positioned as a crucial asset and a source of creativity for climate adaptation, also informing UNESCO and its advisory bodies' approaches. Considering heritage through the lens of climate change also challenge heritage understanding, knowledge production/management inside the design processes. The complex nexus heritage-climate change asks to re-define, from a design perspective, knowledge management approaches, methodologies and tools. Knowledge management is crucial inside the design process for heritage transition to climate heritage: the way and from whom we gather multiple data, analyze process, results and experiences and disseminate them are key aspects for increasing the effectiveness and impacts of adaptation process. With this regard, UNESCO cultural landscapes, as 'living' and 'continuous' landscapes, are envisioned as possible climate experimental laboratories, able to respond to the international organizations' calls for capacity-building, multi-level creation, management and exchange of knowledge through climate adaptative design process. With this purpose the site of The Sassi and the Park of the Rupestrian Churches, Matera, Italy has been selected as a hologram of Mediterranean cultural landscapes and a

possible prototype for a design-oriented knowledge model for climate resilience. From an experimental point of view, the research intends to elaborate the CROA (Climate Resilience Operational Atlas), conceived as a collective and inclusive platform which aims at sustaining a dynamic, multi-scalar, participatory and design-oriented knowledge process which will inform the update of the Site's Management Plan. The Atlas could be interpreted as knowledge process, understood as a mapping tool and a focus on what is possible, in which local groups and communities, and their Endogenous Way of Knowing, would play a central role in guiding socio-ecological adaptation processes opening to sustainable development scenarios.

Keywords – Climate Change, UNESCO Cultural Landscapes, Sustainable Development, Adaptation, Design.

Paper type – Academic Research Paper

1 Introduction

The present contribution summarizes recently-started research inside the UNESCO Chair on Mediterranean Cultural Landscape and Communities of Knowledge on climate heritage of the UNESCO cultural landscape of Sassi and the Park of the Rupestrian Churches, Matera, Italy. From a theoretical point of view, it intends to understand present constrains and future possibilities concerning design-oriented knowledge management process for climate heritage adaptation, by focusing on the nexus between climate change and heritage. From an operational point of view, its objective is to elaborate a design-oriented knowledge model for a climate-resilient management of the UNESCO site. The research process aims at elaborating a holistic, integrated and multidisciplinary knowledge model/process through which monitoring climate induced changes today and, in the future, and to plan adaptation strategies for the UNESCO site according to the 'Community of Knowledge' mission from UNESCO Chair. 'Community of knowledge' concept (Colonna, 2019, 36) which has also informed the property's Management Plan, explores the knowledge dynamics patterns inside the UNESCO cultural landscape of Matera- with a specific focus on community engagement, cultural significance and cultural identity processes and local knowledge mapping- guiding towards 'a solidarity-based knowledge economy.'(Colonna, 2020, 36) How can 'Community of Knowledge' of the Sassi cultural landscape can contribute in climate adaptation process? Which approach, what methodologies and tools can be implemented? The long-term ambition is

to transform the cultural landscape of Sassi and the Park of the Rupestrian Churches into an experimental laboratory and a prototype for climate heritage resilient adaptation, exploring the complexity underneath the Community of Knowledge concept, by addressing heritages, climate change and communities' entanglements.

2 Climate Change, Heritage and Adaptation. Changing perspectives

Within the Heritage studies, an interesting transdisciplinary debate is arising on the relationship between heritage and contemporary uncertainties, in particular with climate change, one of the greatest challenges of our time (IPCC, 2013). From a 'stability under threat' (Terril in Harvey and Perry, 2005) starting vision - aimed at highlighting exclusively the negative impacts on heritages to be preserved as unchanged -, recently a more convincing line of investigation emerged which explores heritage and climate change nexus in all its complexity. Heritage, a 'fundamental resource for human development' (Albert et.al, 2013) is positioned, inside a socio-ecological framework, as a crucial asset and a source of creativity for climate adaptation, leveraging the differently adjectivized concept of transformation. (Folke et al., 2010; Pelling, 2011; Harrison, 2012; Harvey and Perry, 2015). Adaptation appears to be a key concept in exploring the nexus between heritage and climate change, slowly also informing UNESCO and its advisory bodies' approaches (ICOMOS, 2018), opening up to more up-to-date ways to support heritage-based sustainable development scenarios in a changing climate. In 'The Future of Our Pasts' (ICOMOS, 2019) the concept of adaptation is at the very center of the discussion and, its defined, as 'the ability of a system to adjust to potential damage, to take advantage of opportunities or to respond to consequences' (ICOMOS, 2019, 92), ri-elaborating the definition from IPPC report. Adaptation continues to be explored inside climate change cultural heritage research field: 'reactive', 'proactive' and 'planned' (Sesana et. al., 2018), 'persistent', 'autonomous' and 'anticipatory' adaptation (Seekamp and Jo, 2020) and other definitions represent, through categorization, the effort to better understand adaptations dynamics inside cultural heritage challenged by climate change, and how this will impact on traditional practice. 'Cultural heritage, whether tangible or intangible, is sustainable to the extent that it has the capability to adapt to change through creative transformation and continues to develop' (Holtorf, 2018, 643). The continuity in changes, if we think about the

specific category of cultural landscape, is one of its founding characteristics: traditional communities continue to adapt the environment they live in according to ever changing economic, social, cultural and also climatic circumstances, and transformations occurring in the environment are the result of adaptation processes. Considering heritage through the lens of climate change also challenge heritage understanding, knowledge production/management inside the design processes, interpreted as a knowledge agent (Bertola and Teixeira, 2003); consolidated approaches and practices need to be re-discussed, in order to cope with present and future uncertainties. As quoted in the Paris Agreement, adaptation should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous people and local knowledge systems. (Paris Agreement Article 7.5, 2016). The issue of knowledge and understanding is crucial to sustain the adaptation process opening to climate heritage transition. In particular, the role of 'Community of knowledge' will be explored in order to understand operationally how this concept could inform a design-oriented knowledge management process focused on climate adaptation for the UNESCO Cultural Landscape of Matera.

3 UNESCO cultural landscapes as Climate Experimental Laboratory

Blurring the boundaries between natural and cultural, non-human and human, tangible and intangible, place and landscape, local and global, scientific and traditional knowledge, UNESCO cultural landscape are expression of the dynamic and processual relationships between man and the environment; they could be interpreted as transient results of adaptation processes triggered by economic, political, social, cultural and also climatic changes, which originated unique bio-cultural diversities valued of global relevance. Climate change impacts on cultural landscape, both those already underway and those that will come in the future; it requires efforts to understand them, develop appropriate knowing methodologies and tools, in order to elaborate adaptive strategies and action, and share it inside UNESCO World Heritage List framework and beyond. UNESCO cultural landscapes, because of their global relevance and the network they are in, can be envisioned as climate experimental laboratories, able to respond to the Intergovernmental Panel on Climate Change (IPPC, 2014, 2018), United Nation Educational, Scientific and Cultural Organization's (UNESCO, 2008), International Council of Monuments and Sites (ICOMOS, 2019) calls for capacity-building,

multi-level creation, management and exchange of knowledge through climate adaptative design process that could open to sustainable development scenarios (Moscatelli, 2022, 2), coherently with the United Nations'2030 Agenda and its Sustainable Development Goals (UN, 2015). Inside the research, and coherently with the vision of 'Laboratory of Sustainability' (Management Plan, 2014, 89) the UNESCO site of Matera is envisioned as a hologram of Mediterranean cultural landscape, with a focus on present and future asymmetries climate change will introduce or exacerbate; it is also interpreted as a possible experimental laboratory to test process and practices for a more up to date design-oriented knowledge management process.

4 The UNESCO cultural landscapes of the Sassi and the Park of the Rupestrian Churches

Located in the southern Italian region of Basilicata, The Sassi and the Park of the Rupestrian Churches of Matera has been inscribed in the World Heritage List (WHL) in 1993 as a "[…] unique witness to man's activities." (ICOMOS, 1993, 12) The site shows that man occupation had evolved harmoniously with the environment over millennia. Its Outstanding Universal Value (OUV) "stems from the symbiosis between its cultural and natural characteristics." (ICOMOS, 1993, 12) Covering an area of 1,016 ha, the property, an example of "remarkable and intact troglodyte settlement" is made up of the ancient districts of the city of Matera (the Sassi) and of the Park of the Rupestrian Churches. "The morphology of the territory, characterized by deep ravines and bare highland plateaus, integrated with ancient cave churches, shepherd tracks marked by wells, and fortified farmhouses, form one of the most evocative landscapes of the Mediterranean." (UNESCO OUV Brief Synthesis, 1993). Inscribed in the WHL with criterion (iii), (iv) and (v), for the first time, the concept of cultural landscape was introduced inside the motivation for inscription, opening to other inscription in the next decades. "An ingenious system with a history stretching back thousands of years, where necessity has led to the best possible use of natural resources by managing water, soil and energy appropriately and harmoniously". A complex ecosystem resulted from the mutual adaptation between man and nature that has been interpreted as an "example for the sustainable city, a metaphor for a new model and a proposal for the entire planet." (Laureano, 2011, 21). Although this vision has been substantially disregarded from an operational and applicative point of view

since its nomination as a UNESCO site and later as Matera Capital of European Culture (2019), it still constitutes a founding horizon that the present research embraces in its attempt to look at the Sassi and the Park of Rupestrian Churches as a global hologram for climate resilient UNESCO cultural landscape. But its heritages are not limited to the UNESCO perimeter. Matera is a living heritage archipelago, made up by the Sassi and the rupestrian settlements, but also of the Post WW II modern experimental neighborhood and the community-based cultural significance process which are occurring in its widespread suburbs. Heritage process is assumed as possible asset for sustaining climate adaptation process beyond UNESCO zones. To free its potential, it is necessary to re-orient consolidated knowledge management practices, operationalizing the role of community and group and of the concept of Community of Knowledge in a climate resilience perspective. The UNESCO site is today affected by violent but also elusive climatic events, and will continue in the future. Heat waves are expanding their annual duration; flashfloods and windstorms are increasing in frequency and intensity. All this is producing negative ecological, social and economic impacts, affecting people's health and quality of urban spaces. The ecological paradigm, in its etymological meaning, is recalled in the Management Plan of the property asking for a discontinuity with the recent past and stressing the need of an experimental dimension (Management Plan, 2014, 54) able to reconnect community and its heritages by envisioning it as "bearer of knowledge." (Management Plan, 2014, 62)

Together with other anthropogenic pressures like tourism in the Core Zone, soil consumption and residential sprawl inside the Buffer Zone, climate change is making the UNESCO site more vulnerable and exposed to increasing risks, affecting both tangible and intangible dimension of heritage. Understanding impacts on heritage and communities, beyond the single event, in a longer time scale, is crucial to orient people-centered climate adaptation strategies and promoting a sustainable development coherently with Agenda 2030.

5 The Climate Resilience Operational Atlas

From an applicational point of view, the research intends to elaborate the CROA (Climate Resilience Operational Atlas), conceived as a collective and inclusive platform which aims at sustaining a dynamic, multi-scalar, participatory and design-oriented knowledge process which -coherently with the four strategic

themes of the Management Plan: 1) Understanding of WH site, 2) safeguarding the OUV, 3) Use and promotion of the quality of life, 4) effective management (Management Plan, 2014, 87)- could help envisioning shared sustainable development scenarios through climate adaptation. The Atlas could be interpreted as knowledge process, understood as a mapping tool and a focus on what is possible, in which local groups and communities, and their Endogenous Way of Knowing, would play a central role in guiding socio-ecological adaptation processes. The concept of adaptative continuity is crucial for envisioning climate resilience and is assumed as structural inside the atlas process. To be more precise, the atlas is more like a collective and inclusive platform with a spatial dimension which intends to sustain people-centered climate-adaptive knowing process but also to understand past dynamics and future climate impacts, coping with the uncertainties of dealing with climate change's projections. It has been conceived around five strategic principles that had been inspired from 'The Future of Our Past: engaging cultural heritage in climate action' (ICOMOS, 2019) and which tries to operationalized the Community of Knowledge concept.

People-centered value-based approach. Prioritize what people value of the places through community engagement and participation, fostering social inclusion and equity, through people-centered inventory and cultural mapping process to inform climate heritage management. Understanding cultural significance of a site and social reaction to extreme climatic events, but not limited to, is crucial to stress present changes and their economic, ecological and social overlaying impacts. Explore how people perceived present climate variability, its signals and impacts on places is relevant to orient adaptation strategies.

Adaptative continuity. Understanding past adaptability, social, economic and environmental, and relate it to current challenges is crucial to understand present and future vulnerabilities. Exploring how local communities had faced and adapt to sudden (i.e. catastrophes, mass displacement) or slow changes, both natural and anthropogenic, and their implication on cultural landscape (i.e. land use, architecture, etc.) and on the Endogenous Way of Knowing (i.e. traditional knowledge and practices, etc.) (ICOMOS, 2019, 97) in essential. Understanding how communities interpret the cultural landscape as a continuum of adaptation process, also climatic, and how much of this adaptation persists within both tangible and intangible dimension of heritage is a fundamental issue. This multi-scalar, multi-temporal and multi-disciplinary knowing process can contribute to

raise awareness of the living or continuous dimension of cultural landscape and to stimulate the emergence of a shared risk culture.

Integrative and multidisciplinary mapping. Acquiring, managing and sharing data is crucial and should be done in a holistic, multidisciplinary, integrated and dynamic way. Climate science and inter-sectoral datasets -concerning tourism, environmental patterns, etc.- should be integrated with predictive methodologies concerning climate risk and vulnerability. Spatialization can contribute to the integration of different dataset in time, making more accessible the information collected. Climate change is a long-term phenomenon and its impacts should be valued according to a multi-temporal, multi-scalar approach in order to consider past, present and future vulnerabilities and risks and also opportunities. Scientific dataset should also be integrated with intangible issues such as cultural significance, community vulnerability and resilience, traditional livelihoods in relation to heritage places.

Complex monitoring. Heritage monitoring in essential to understand present impact but also to define adaptation strategies and value actions in a long period. Impacts monitoring - that should be conducted through diverse knowledge producers, i.e., data scientist, researcher, institution, local people and groups- will regard heritage places, architecture, communities and local knowledge, both through high-tech and low-tech approaches, fostering the idea of a collaborative knowledge system.

Transferability. Sharing knowledge and information concerning adaptation process and practices. Transferability is crucial not only among stakeholders, researchers and professional involved in the UNESCO property of the Sassi and local communities, but also inside the network of UNESCO cultural landscape, fostering multi-level knowledge exchanges.

In a first phase, the mapping process will focus on the Buffer Zone area where, due to its characteristics, the combined effects of anthropogenic pressures can be found more extensively, thus being more fragile also to the present impacts of climate change. Inside a general a framework of present and potential fragilities, five quadrants at a territorial scale were chosen, summarizing in themselves a series of characteristics and recurring fragilities within the Buffer Zone.

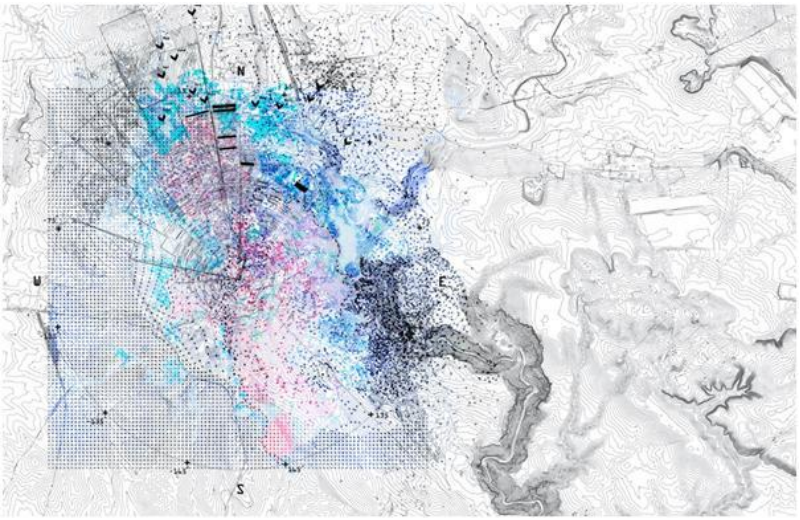

Fig 1. The CROA. Integrating climate change phenomena (windstorms, flashfloods and heatwaves), social and ecological vulnerability and tourism pressure in the UNESCO Cultural Landscape of the Sassi and the Park of Rupestrian Churches, Matera. © A. Raffa.

An initial large-scale mapping process had been followed by field explorations and dialogue with group and representatives of local communities, with the objective to identify critical heritage places on a local scale, starting from what they consider urgent. Present and possible fragilities, as well as possible local impacts of climate change, were also introduced as another level of reading and interpretation, underlining the opportunities that adaptation actions could give in a small and large temporal/spatial scale, also raising awareness on the climate issue and the potential of community engagement and participation in adaptation process. The survey work has allowed to collect information of different nature -narrations, documents, practices, etc.-, concerning changes and adaptation that would hardly be possible to reach without community involvement. Once this preliminary phase will be accomplished then a multi-level, multi-oriented and dynamic operational topography will result, understood as an open project / process, which is elaborated thanks and will be offered to communities and local groups of active citizenship so that they can implement it through following explorations and specify it starting from their evolving needs and values (Raffa, 2021).

6 Conclusions

Intersecting complex issues such as cultural landscape, climate change and people-centered adaptation requires an integrated, holistic, multidisciplinary and open to differences approach to cultural heritage (Brabec and Chilton, 2015), which draws on scientific knowledge as well as on local and traditional knowledge, and which, in addition to supporting awareness-raising processes on climate issue, open to people-centered climate-adaptative development scenarios for the UNESCO site of the Sassi and the Park of the Rupestrian Churches. The ongoing process, which will inform the next update of the Management Plan, intends to frame the UNESCO site as an experimental laboratory on climate adaptation operationalizing the concept of "Community of Knowledge", defining operational methodologies and tools that could be applied also in other UNESCO cultural landscapes.

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(Sustainable) Platforms Ecosystems: Integrating the Green into the Blue

Antonio La Sala*

Department of Management
Sapienza University of Rome (Italy)
9, Via del Castro Laurenziano (00161), Rome

Ryan Patrick Fuller

College of Business Administration
California State University, Sacramento (USA)
6000 J St, Sacramento, CA 95819

Laura Riolli

College of Business Administration
California State University, Sacramento (USA)
6000 J St, Sacramento, CA 95819

Maria Vincenza Ciasullo

Department of Management and Innovation Systems
University of Salerno, Fisciano, Italy;
Faculty of Business, Design and Arts, Swinburne
University of Technology, Kuching, Malaysia
Department of Management
University of Isfahan, Isfahan, Iran

** Corresponding author*

Abstract

Sustainable innovation has become an increasingly important topic in recent years, as society faces emerging challenges related to sustainability. Rooting on a wide review of sustainable innovation and framing digital platform ecosystems as a way to create new markets, promote regional specialization, and provide long-term horizons for political action, the paper proposes a conceptual framework to highlight the pivotal role of the platform sponsor in guiding and controlling the development of sustainable innovation on the whole platform ecosystem. This involves setting clear goals, defining metrics, and establishing rules for participation. The platform sponsor also plays a critical role in

fostering collaboration and co-creation among users, facilitating the sharing of knowledge and resources, and creating a culture of innovation and sustainability: in this, algorithms play a key role in enabling green and blue technology recombination, supporting sustainable decision-making. By integrating these technologies, digital platform ecosystems can support sustainable practices across a range of industries and reduce the environmental footprint of human activities.

Keywords – Sustainable innovation; digital platform ecosystem; green and blue; algorithms.

Paper type – Academic Research Paper

1 Introduction

The past two decades have witnessed an increase in interest in the topic of sustainability (Aghion et al., 2009; EC, 2010; Montalvo et al., 2011; Cillo et al., 2019) and several historically relevant forces contributed. Firstly, the great number of long-term challenges such as climate change, ageing populations, pollution, resource scarcity (Montalvo et al., 2006; Taleb, 2012; Harari, 2018); secondly, the reorientation of the international socio-economic environment towards multipolarity of interests and the consequent need to redefine competitive rules (Foray, 2009; Contractor et al., 2010; Taleb, 2018). Thirdly, the growing distrust and delegitimization, in an increasing number of advanced economies, towards policies aimed at ensuring social welfare and employment after the economic meltdown of 2008. The financial crisis has made clear how a 'contingent' mentality, centered on short-term strategies, policies, and actions, can result in loss of social equilibrium, ecological shocks, deep rifts in the fabric of values (Harari, 2018).

In the broad socio-political debate, there is broad consensus on the urgency of generating innovation to meet these challenges (EC, 2009; EC, 2010; OECD, 2010, 2011, 2012). Future competitiveness is no longer defined solely through the ability to survive in current markets, but above all through the ability to create new sustainable markets driven by innovation (Montalvo et al., 2011). In the case of the challenges posed by sustainability, the notion of innovation has often been deemed successful (Porter and Kramer, 2011). This is evident from the large increase in capital flowing into sustainable innovations (Ethical Markets Media, 2011; Montalvo et al., 2011). Sustainable innovations are creating new global markets, enabling the smart specialization of certain regions and offering

governments long-term horizons and new space for policy action (West, 2017; Harari, 2018; Mattila et al., 2020). Such evidence has contributed to increasing the interest of companies in implementing sustainable business models (Latour, 2020). Despite the great centrality of the topic at hand, however, little has yet been said about how (sustainable) innovations can be directed towards creating sustainable business models by establishing a link between the firm and its supra-systems of reference (Barile, 2009; Boons and Wagner, 2009; Wever et al., 2010; OECD, 2012; Cillo et al., 2019; Latour, 2020). The present work aims to fill this gap.

The paper is organized as follows: after a framing of the concept of sustainable innovation (Section 2), the paper deepens digital platforms ecosystem as emerging models for the diffusion of sustainable innovation thanks to green-blue technologies integration (Section 3). This is followed by implications, and conclusions (Section 4).

2 Digital platform ecosystems for sustainable innovation: the state of the art

A platform ecosystem is a type of inter-firm/inter-stakeholder relationship in which a focal firm (the platform sponsor) mediates among multiple groups of participants (e.g., consumers and suppliers; developers and complementors), thereby creating value within the ecosystem itself. Platforms can be classified as transaction platforms (Jacobides et al., 2018; Cusumano et al., 2019), i.e., mediation channels (or marketplaces) between buyers and sellers; and innovation platforms that provide – in addition to simplified transactions – technological infrastructures to third parties, the complementors, for the development of products to be offered to platform users (Cusumano et al., 2019; Zeng et al., 2021). In addition to the platform sponsor, who acts as an orchestrator of values, resources and competences, platforms consist of two further sides: the demand side and the supply side (Calabrese et al., 2021; Zeng et al., 2021). On the demand side, consumers and buyers have access to a variety of services aimed at ensuring the reliability of transactions and the quality of the offer (e.g., via user ratings and reviews); on the supply side, users have to comply with the rules of access to the platform, pay transaction fees and meet the quality requirements set by the platform sponsor (Boudreau and Hagiu, 2009; Nambisan and Baron, 2013). Furthermore, both sides of the platform benefit from the value created within the ecosystem, which is not easily accessible from the outside: a common

infrastructure and a large pool of potential demand; the great heterogeneity of supply and the effectiveness of the feedback system.

Indeed, a central feature of platform ecosystems is the presence of indirect network effects among participants on different platform sides: the value realized on one platform side depends on the number of participants on the other side (Armstrong, 2006, Parker et al., 2016; Parker & Van Alstyne, 2018; Zeng et al., 2019). This is the well-known *chicken-or-egg problem* (Caillaud & Jullien, 2003): a sufficient number of participants from one side of the platform is necessary to attract those from the other and vice versa. Thus, the greater the market share gained, the easier it becomes for the platform to gain future market share (Arthur, 1996): incentivizing firms and customers to join a platform and interact with each other to trigger network effects is a key role of the platform sponsor (McIntyre & Srinivasan, 2017).

Moreover, such a network of relationships allows for the effective use of under-utilized resources, focusing on their accessibility rather than their exclusive ownership, on equitable and sustainable distribution, reduced costs of access to resources and thus their democratic diffusion (Botsman and Rogers, 2010; Albinsson and Perera, 2012; Martin, 2016; (Srnicek, 2017; Chen et al., 2018; Zeng et al., 2021; Mair and Rathert, 2021), enhancing social, economic and environmental well-being and pushing innovations logics ahead (Black and Cherrier, 2010; Jin et al., 2018; Vith et al., 2019).

Therefore, the relationship between sustainable innovation and the pervasiveness of digital platforms possesses great transformative potential, giving rise to new models of territorial regulation, new ways of participation/ distribution/recombination of value and resources, new welfare and market models and new types of social capital (Belk, 2014; Davidson and Infranca, 2015; Matzler et al., 2015).

This implies that socioeconomic value creation is shifted from the inside to outside of the platform boundaries. However, as mentioned, in creation, convergence and alignment of digital platforms' socioeconomic value, the orchestration role of the platform sponsor is pivotal.

Thus, digital platform ecosystems are revolutionising market logic, affecting international competitive dynamics and the evolution of several technological trajectories (McIntyre et al., 2020; Simone, 2020): they exploit technology to connect people, organisations, and resources within an interactive ecosystem that can constantly reproduce itself. These reproductive capacities allow digital

platform ecosystems entering and creating new markets (Simone et al., 2020). Under the lens of sustainability, this happens by combining very different functionalities and technologies and expand into new markets (Greenfield, 2017) and developing innovative, hybrid, and sustainable solutions (Mattila et al., 2020). A clear example of this dynamic is the integration of green and blue technologies: the first typology makes it possible the joint management of environmental challenges and value creation aims (OECD, 2009; 2011; Calabrese et al., 2021); the second typology (i.e., digital technologies) opens new spaces of possibilities and opportunities.

This green/blue binomial seems to permit the whole social fabric to coordinate environmental capitalism with digital capitalism toward sustainable innovation, giving also rise to new mechanisms of governance (Floridi, 2020).

However, it is licit to ask: what is meant by sustainable innovation? In what follows, the paper tries to frame an answer.

Indeed, in recent years, there has been an increasing recognition of sustainable innovation as a response to present environmental and social challenges.

Sustainable innovation is a type of innovation that integrates ecological, social, and economic considerations into social and business systems. This type of innovation requires a systemic, architectural, and radical approach that goes beyond incremental adjustments and requires the transformation of larger parts of production or consumption systems.

To further understand sustainable innovation, numerous definitions and perspectives have been proposed. The European Commission defined eco-innovation as "the production, assimilation or exploitation of an innovation in products, production processes, services, or management and business methods that aims to prevent or substantially reduce environmental risk, pollution, and other potential negative impacts from resource (including energy) use" (EC, 2008).

Carrillo-Hermosilla et al. (2010) followed by Adams et al. (2016), and Cillo et al. (2019) defined eco-innovation as an innovation that improves environmental performance.

Based on what emerges this debate, sustainable innovation can be defined as innovation that improves sustainability performance, where such performance includes ecological, social, and economic criteria (Calabrese et al., 2021). However, since these criteria are constructivist and cultural in nature, both its meaning and characteristics differ in different contexts (Hart and Milstein, 1999; Prahalad, 2005; Seelos and Mair, 2005, 2007; Tukker et al., 2008; Yunus et al., 2010).

Boons (2009) argues that innovations for sustainable development need to overcome the incremental logic, calling for a wider transformation of production/consumption systems. In this line, incremental innovations can only lead to improvements in sustainability performance but not to a concrete reconfiguration (Boons et al., 2013).

Following this logic, sustainable innovation can be analyzed along three levels: organizational, inter-organizational, or social (Boons & Lüdeke-Freund, 2013).

At the organizational level, the focus is on the ability single firms have in developing green technologies for effective value propositions design (even if, more than often, organizations themselves are seen as black boxes) (Arimura et al., 2007).

At the inter-organizational level, studies focus on the nodes of inter-organizational networks involved in innovation generation, examining the relevance of relationships with other actors in the governance of sustainable innovation processes. These studies also focus on the interactions between different factors that impact the innovative capacity of an enterprise (Edquist, 1997; Weber and Hemmelskamp, 2005; Seuring and Müller, 2008).

At the societal level, studies aim to understand transitions or paradigm shifts and how social change is connected to technological change. These studies are particularly interested in framing the value that brings actors together around a technology, whether existing or new. Additionally, the creation and diffusion of norms, values, and cultural practices play a crucial role in the adoption and success of sustainable innovations in society (Geels, 2004; Hargadon and Douglas, 2001; Shove, 2010).

Furthermore, the literature on sustainable innovation emphasizes the importance of collaboration and co-creation between different actors, including firms, governments, civil society organizations, and individuals, to achieve sustainable development goals (Bocken et al., 2015; Schiederig et al., 2012). This requires a shift from a traditional linear model of innovation to a more collaborative and iterative process that involves the participation and engagement of diverse stakeholders throughout the innovation process (Jansen et al., 2018).

3 Spreading sustainable innovation through digital platform ecosystems

As previously mentioned, a sustainable digital platform ecosystem can be developed by leveraging two key technology-driven pillars: green technologies and blue technologies. By combining these technologies, sustainable and innovative solutions can be achieved, which can fundamentally transform how firms and societies innovate, produce, and consume products and services. Green technologies are focused on creating value and innovatively managing environmental issues, while digital technologies are considered as blue technologies that can complement and enhance the capabilities of green technologies (Floridi, 2020). In real-life scenarios, the convergence of green and blue technologies is evident in the design of sustainable solutions, especially in modern cities where sustainable management models are being implemented. A prominent example of this convergence is the electric scooter, which is classified as a green technology. In cities, these technologies are linked to blue technologies, such as a scooter sharing app that enables users to access the service. Therefore, digital platforms can serve as a model to integrate green and blue technologies, facilitating their convergence towards sustainability (fig 1).

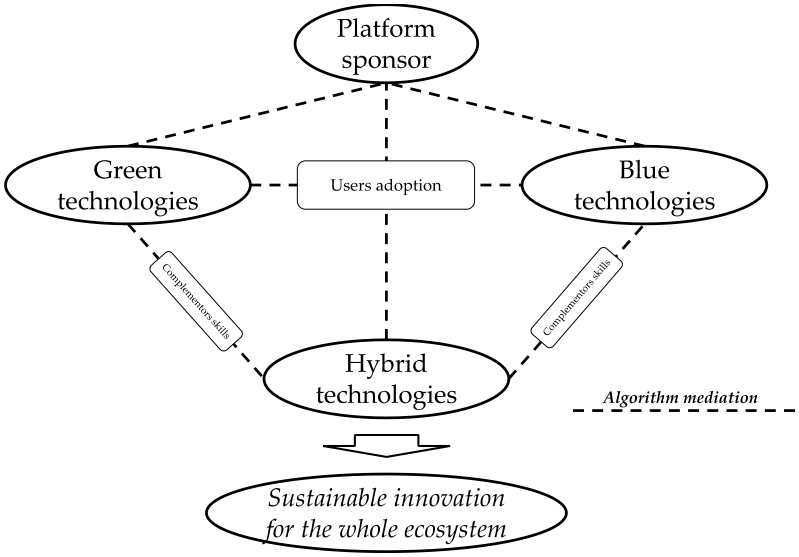

Figure 1. Green and Blue technologies integration towards sustainability
Source: our elaboration

The goal of this section is to explain how a sustainable digital platform ecosystem emerges and emphasize the role of digital algorithms and platform sponsor in this emergence phase. Digital algorithms play a vital role for three main reasons (Calabrese et al., 2021):

1. *data collection and filtering* are carried out through algorithms that record, process, and filter the activities of each user and information from external markets in real-time;
2. the algorithmic language is adopted by the members of the digital platform ecosystem to communicate and share information, knowledge, and technologies with each other;
3. the algorithmic language allows for the hybridization of technologies since different technologies can communicate with each other, which enables the digital platform ecosystem to merge and hybridize green and blue technologies. This peculiarity facilitates the evolution of a sustainable digital platform ecosystem (Greenfield, 2017).

Indeed, green and blue technologies can merge by using the same algorithmic language, resulting in a sustainable digital platform ecosystem with powerful and hybrid ideas, as mentioned by Greenfield (2017). The development of a sustainable digital platform ecosystem involves four crucial steps Cusumano et al. (2019): identification of market sides, chicken-egg problem solution, collaborative governance model design, rules of conduct establishment and enforcement.

Regarding the first step, the platform sponsor needs to use the platform's digital algorithms to connect the supply and demand sides of the market. The algorithms should be instructed to search for green technology developers and users and to connect both market sides. For instance, Apple is particular about selecting green solution developers like Too Good to go, Ecosia and Recycle Coach.

Further, the second step attains to the chicken – or – egg problem solution: the platform sponsor must attract users from both sides of the digital platform, giving rise to both direct and indirect network effects, attracting users through the introduction of blue technologies which complement and integrate available or new green technologies, such seen in the case of Apple iOS platform.

The third step refers to the design of collaborative governance models: to ensure digital platform ecosystems being sustainable, the platform sponsor needs to create a business model that incorporates a collaborative-driven logic of governance, allowing all actors to communicate as peers through platform's

digital algorithms. These algorithms identify decisions shared by all ecosystem actors, ensuring that they all participate in decision-making and sustainable innovation processes, as exemplified by the *We Dont HaveTime Climate Change* iOS app.

Eventually, the fourth step refers to the need to establish and enforce rules of conduct.

To ensure smooth functioning of the digital platform ecosystem, it is the responsibility of the platform sponsor to establish and clearly communicate the participation rules to all ecosystem actors. The sponsor must also specify how digital algorithms monitor adherence to these rules and enforce penalties in cases of non-compliance by any actor.

Additionally, the sponsor determines the degree of decentralization in decision-making and takes on the role of guiding and controlling the ecosystem through instructions given to digital algorithms Gawer and Cusumano 2002 a, b; Eisenmann et al. 2011; Cusumano et al. 2019). As an example, Apple's rules revolve around climate change, resources, and smarter chemistry (Apple, 2020).

Following these four steps, the platform sponsor could create a sustainable ecosystem characterized by peer-to-peer procedures through which actors sustainably co-create value (Barile et al., 2017).

4 Implications and conclusion

Even if the digital platform ecosystem phenomenon is under the spotlight of managerial studies, no frameworks show how sustainable digital platform ecosystems emerge and the importance of the platform sponsor and digital algorithms in this emergence phase. This paper is a first step in this direction, highlighting procedures to be followed to build a sustainable digital platform ecosystem. It shows the critical role played by the platform sponsor and the tool used by the platform sponsor, the digital algorithm, to design a sustainable digital platform ecosystem. The work also offers valuable support in the decision-making processes that affect the digital platform ecosystem in choosing strategies to be implemented. In particular, the proposed framework can guide the implementation of innovative, hybrid and sustainable strategies. In particular, it is explained how a digital platform ecosystem can evolve into a sustainable digital platform ecosystem by designing a technology ready to combine and recombine with new green technologies. The limits of the research are to be

found in the purely theoretical nature of the work. The main limitation lies in need to support this study with empirical evidence. Future research will be oriented toward overcoming this limitation and deepening the role of hybrid innovation, taking on different directions, peculiarities, and gradients thanks to the sustainable digital platform ecosystem.

Concluding, this paper has shed light on how green and blue technologies can merge into powerful, hybrid ideas through the digital platform ecosystem. By focusing on the role of the platform sponsor and digital algorithms used by digital platform ecosystems, the research elaborates a framework that illustrates the mechanisms through which a sustainable digital platform ecosystem can emerge, allowing green and blue technologies to merge. The paper shows that the clear identification of green developers and the construction of a collaborative governance model contribute to the emergence of the sustainable digital platform ecosystem. It reveals that the platform sponsor plays a crucial role in direction and control, while the algorithm plays a key role in rapidly connecting all the actors in the ecosystem and combining very different functionalities and technologies such as green and blue technologies. To conclude, the *sustainable digital platform ecosystem* represents a new organisational model that fully meets the need for a sustainable twist on innovation by allowing innovation and sustainability to be combined and allowing natural limits to be fully exploited (Crutzen, 2006).

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Circular Economy Disclosure through Social Media: An Empirical Analysis on Twitter

Vitiana L'Abate

LUM University
Casamassima (BA), Italy
S.S. 100 km 18

Nicola Raimo*

LUM University
Casamassima (BA), Italy
S.S. 100 km 18

Filippo Vitolla

LUM University
Casamassima (BA), Italy
S.S. 100 km 18

* *Corresponding author*

Abstract

In recent years, to solve the problems related to sustainability, there is an increasing need for a transition from linear production and consumption systems to new models oriented towards recycling, reuse, reuse and reuse. In the academic field, several scholars have turned their attention to the adoption by companies of the new circular economy models. Due to the interest of a large number of stakeholders in issues related to the circular economy, several scholars have begun to explore the circular economy disclosure practices of companies. Despite this, studies on the topic are still limited. The purpose of this study is firstly to examine the level of circular economy information disseminated through Twitter by companies and, secondly, to examine the impact of some characteristics of companies on the level of circular economy disclosure. Empirical results show that the most profitable and most indebted companies disclose a greater amount of circular economy information through their official Twitter accounts. This study contributes to enriching the academic literature and provides important practical contributions.

Keywords – Circular economy, Disclosure, Social media, Twitter

Paper type – Academic Research Paper

1 Introduction

Ecosystems are crucial for sustaining life on the planet, but they have not always been treated with care. Overuse, overconsumption and neglect have caused harm to many vital ecosystems (García-Sánchez et al., 2021; L'Abate et al., 2023). The current events of the COVID-19 pandemic and the Russia-Ukraine war have further highlighted the need to use resources responsibly and avoid waste. In this context, the circular economy is gaining more attention as a solution to environmental problems, especially in terms of recycling and recovering resources. In many countries and particularly in the European Union, it is considered a fundamental aspect of sustainable policies and a key driver of the transition towards global sustainability (García-Sánchez et al., 2022a). The NextGenerationEU Plan also recognizes the circular economy as a way to aid economic recovery following the COVID-19 pandemic (García-Sánchez et al., 2022a). The circular economy is an economic model in which materials and resources are used, recovered and regenerated in a continuous manner to maintain the value of resources within the economy for as long as possible (Gunarathne et al., 2021). The goal is to reduce waste and environmental impact, create resilient local economies and support sustainable development. The circular economy is based on three fundamental principles: designing out waste and pollution, keeping resources in use for as long as possible and regenerating natural systems (Millar et al., 2019). Despite the importance of the circular economy for stakeholders, companies are not effectively and clearly communicating data and information about this production and consumption model (Barnabè & Nazir, 2021). Even though more companies are starting to adopt circular economy disclosure practices, there are still issues and delays due to a lack of specific measurement tools and reporting standards (Elia et al., 2017), as well as a lack of a commonly accepted language for discussing these topics (Ünal et al., 2019; Barnabè & Nazir, 2021). These circumstances have led to a variety of different ways of measuring and presenting information about the circular economy, using different techniques and tools (Garza-Reyes et al., 2018; Barnabè & Nazir, 2021).

In recent years, the advent of digitalization has provided new digital platforms for the dissemination of circular economy information. In particular, one way is the use of social media (Dumay, 2016). Social media have changed the disclosure landscape, offering further opportunities for research on the role of disclosure.

They facilitate firm-directed, one-to-many communications that bypass traditional media and allow a firm to broadcast its intended message to a large network of stakeholders (Lee et al., 2015).

In light of the relevance of the circular economy and social media, this study, firstly, intends to analyze the amount of circular economy information disseminated by companies through Twitter and, secondly, the factors capable of favoring or hindering circular economy disclosure through this social platform. In this regard, this study, in the wake of Barnabè and Nazir (2021), uses the glossary provided by the U.S. Chamber of Commerce Foundation to identify terms related to the circular economy and a count of the number of tweets provided by companies on their official Twitter account containing those terms. Furthermore, it provides for the implementation of an econometric model aimed at identifying the determinants of circular economy disclosure through the Twitter social platform.

The rest of this work is organized as follows: Section 2 presents the literature review and hypotheses development, Section 3 introduces the research design, while Section 4 presents the results and draws conclusions.

2 Literature review and hypotheses development

Due to the recent relevance of the circular economy, several scholars have begun to explore the way companies communicate circular economy information (Istudor & Suciu, 2020; Dagiliene et al., 2020; Barnabè & Nazir, 2021; Opferkuch et al., 2021; Tiscini et al., 2022; Vitolla et al., 2023). Specifically, several studies have examined the different channels through which companies provide circular economy information to stakeholders. In this regard, they focused their attention on the various company documents, including integrated report, sustainability report and annual report, examining not only the level and type of circular economy information contained in them but also the drivers of circular economy disclosure. Instead, in the academic literature there is a paucity of studies exploring other communication channels, such as websites and social media.

With reference to the integrated reports, scholars have begun to explore the communication methods of circular economy information in the light of integrated thinking, as it allows to capture the interconnections between the different categories of capitals and to provide a holistic view of this information (Kunc et al., 2021; Myeza et al., 2021; Barnabè & Nazir, 2021; 2022). In this regard,

Barnabè and Nazir (2021) conducted a content analysis on the content of the integrated report and a case study in order to examine the role of the <IR> framework in the dissemination of circular economy information. The authors demonstrated the presence of important differences in the communication practices of circular economy information, highlighting the relevance and potential of integrated reporting in representing such information. Kunc et al. (2021) came to the same conclusion about the relationship between integrated reporting and circular economy disclosure. In addition, Barnabè and Nazir (2022), through a case study conducted in the agri-food sector, explored how the principles of integrated thinking are applied in the communication and representation of circular economy information within integrated reports. Finally, Myeza et al. (2021), examining the integrated reports of South African mining companies, provided a regulatory framework for integrating circular economy practices into corporate strategy and observed the level of circular economy information contained within this document.

Other studies have examined the relationship between sustainability reporting and circular economy information (Janik et al., 2020; Marco-Fondevila et al., 2021; Opferkuch et al., 2021; 2022; Tiscini et al., 2022). In this regard, Opferkuch et al. (2021) observed that, due to the absence of guidelines for the identification and representation of circular economy information, there is a disconnect between sustainability disclosure and the circular economy. In this regard, Opferkuch et al. (2022), have highlighted that still few companies disseminate circular economy information within sustainability reports. Indeed, the authors observe that the information included in the sustainability reports concern circular economy indicators and objectives. In addition, Tiscini et al. (2022) highlighted that companies still disclose little circular economy information in relation to the circular economy strategy, governance, performance and management within the sustainability reports. Janik et al. (2020), by analyzing the sustainability reports of companies operating in the energy sector, found a focus on greenhouse gas emissions, while little attention was given to circular economy information. Finally, Marco-Fondevila et al. (2021), examining the largest Spanish companies, found that only half of them disseminate circular economy information in their sustainability reports. Other authors have instead explored the content of circular economy information communicated through sustainability reports (Stewart & Niero, 2018; Istudor & Suciu, 2020; García-Sánchez et al., 2022a). In this regard, Stewart and Niero (2018), by analyzing a sample of 49 companies operating in the

consumer goods sector, discovered that business model tactics and circular product design received less attention than other aspects such as core product, procurement strategies, packaging, and end-of-life management. In addition, Istudor and Suciu (2020) examined the sector of food and observed that companies disseminate information regarding emissions, waste reduction and recycling, correct use of resources and sustainable development. Furthermore, García-Sánchez et al. (2022a) found that companies focus their attention on information relating to the reduction of greenhouse gases, the correct use of resources and in general the role of the circular economy in the sustainable development goals. Finally, other authors have examined the drivers of circular economy disclosure (Wang et al., 2014; Dagiliene et al., 2020; Vitolla et al., 2023). In this regard, Wang et al. (2014) found that ownership concentration, institutional ownership and environmental institutional protecting pressures have a positive impact on the level of circular economy information disseminated within sustainability reports. External pressure was also examined by Dagiliene et al. (2020). In fact, the authors observed that the levels of circular economy disclosure are positively influenced by regulations and mimetic pressures, while coercive factors have no significant impact. Finally, Vitolla et al., (2023), examining the sustainability reports of 88 international companies, observed that firm size, firm profitability and firm financial leverage have a positive impact on the amount of circular economy information disclosed.

Finally, other studies have instead examined more types of corporate documents, focusing on the amount of circular economy information disclosed, on the drivers and on the effects of circular economy disclosure (Gunarathne et al., 2021; Kuo & Chang, 2021; Roberts et al., 2022). Specifically, Gunarathne et al. (2021), by analyzing the integrated and sustainability reports, found that Sri Lankan companies disclose a low level of circular economy information. Instead, Roberts et al. (2022), by examining the sustainability reports and annual reports, found higher levels of circular economy disclosure in companies in the automotive sector than in those operating in the aerospace and defense sectors. Still focusing on the sustainability and annual reports, Kuo and Chang (2021) examined the determinants and effects of circular economy disclosure in the Chinese context. More in detail, in relation to the determinants, the authors found that larger firms, state-owned enterprises and firms operating in environmentally-sensitive industries disseminate more circular economy information. Furthermore, in relation to the effects, the authors observed that the dissemination of circular

economy information has a positive impact on the profitability and growth rate of companies.

Instead, the academic literature has paid little attention to the dissemination of circular economy information through social media. Specifically, there is only one study conducted by Esposito et al. (2023) who explored social networks as a communication channel for circular economy information. In this regard, examining the agri-food sector, the authors found that Twitter represents a good channel for the dissemination of circular economy information. Despite this, the companies operating in the agri-food sector have dealt with only a few aspects, communicating on this social network only information on recycling and the circular economy in general.

The literature review shows limited attention to social media as potential communication channels for circular economy information. In addition, the absence of studies aimed at examining the drivers of circular economy disclosure through social media is evident. This study aims to fill this gap by focusing attention on three different corporate characteristics which, by increasing the pressures to which companies are exposed and the stakeholder base, could favor a wider circular economy disclosure. In particular, it examines the impact of three corporate characteristics: size, profitability, and financial leverage. In fact, these variables, for various reasons, influence the attention that companies dedicate to the interests of stakeholders and therefore could influence the level of circular economy information disclosed via Twitter. In fact, larger companies are more visible and have a greater impact on the external environment (Reverte, 2009; Vitolla et al., 2019; Nicolò et al., 2022) while the most profitable companies have a greater availability of monetary resources and want to distinguish themselves from their competitors also through a broad disclosure (Brammer & Millington, 2006; Schreck & Raithel, 2018). Finally, the most indebted companies have a greater need to consolidate a relationship of trust with stakeholders (Branco & Rodrigues, 2008; Andrikopoulos et al., 2014; Sharif & Rashid, 2014; Raimo et al., 2022). In light of this, it is reasonable to expect a positive impact of these variables on the level of circular economy disclosure via Twitter and it is possible to introduce the following hypotheses:

HP1: Firm size has a positive influence on the circular economy disclosure level via Twitter

HP2: Firm profitability has a positive influence on the circular economy disclosure level via Twitter

HP3: Firm financial leverage has a positive influence on the circular economy disclosure level via Twitter

3 Research design

The sample of this study includes 141 companies belonging to the S&P 500 index. The choice of this index is justified by the need to examine larger companies as they are exposed to greater pressure from stakeholders in relation to transparency (Watts & Zimmerman, 1978; Manita et al., 2018). For the purposes of this analysis, only companies operating in the energy (or energy utilities), industrial and basic materials sectors were selected from the initial list. Subsequently, the companies that did not have an official Twitter account and those for which it was not possible to retrieve the data relating to the independent and control variables from the Bloomberg database were excluded. In light of this, the final sample is made up of 141 companies.

The dependent variable of this study is represented by circular economy disclosure level (*CEDL*). It is measured as the natural logarithm of the number of tweets containing information relating to the circular economy published in 2021 on the official Twitter accounts of the companies included in the sample. A manual content analysis was used to measure this variable (Vitolla et al., 2020a; Raimo et al., 2021). In particular, following Barnabè and Nazir (2021) and Esposito et al. (2023), a dictionary-based content analysis was used. The "Glossary of Circular Economy" developed by the U.S. Chamber of Commerce Foundation was chosen as the source for term identification. Following previous studies, the selected glossary was expanded with other concepts leading to the identification of 54 terms related to the circular economy. The terms related to the circular economy were considered both singular and plural form.

In line with the objectives of this study, the recording unit is represented by the individual tweets published by companies through their official accounts in 2021. The data collection was conducted through the "All My Tweets" web application. Each tweet was assigned a score equal to 1 in the event of the presence of one or more terms relating to the circular economy and a score equal to 0 otherwise (Massaro et al., 2017).

The independent variables included in this analysis are: *Firm Size*, *Firm Profitability*, and *Firm Financial Leverage*. *Firm Size* was calculated in terms of the natural logarithm of total assets (Vitolla et al., 2020b; Salvi et al., 2022), while *Firm*

Profitability was measured in terms of return-on-equity (Raimo et al., 2020), calculated as the ratio between net income and shareholders' equity. *Firm Financial Leverage* is a measure of the firm's debt and was measured as the ratio of total debt to total assets (García-Sánchez et al., 2022b; Salvi et al., 2022).

The control variables are: *Energy Sector*, *Board Size*, *Board Gender Diversity*, *Board Independence*, *Audit Committee Size*, *Number of Tweets*, and *Number of Followers*. *Energy Sector* is a dummy variable which assumes the value 1 if the company operates in the energy sector, and 0 otherwise. *Board size* was calculated as the total number of members who make up the board of directors, while *Board Gender Diversity* was measured as the percentage of women on the board of directors. *Board Independence* was calculated as the percentage of non-executive members included within the board of directors, while *Audit Committee Size* was measured in terms of total members who make up this corporate governance body. *Number of Tweets* was calculated as the natural logarithm of tweets posted by the company in 2021 through its official Twitter account, while *Number of Followers* was calculated as the natural logarithm of the number of individuals who follow the company's official Twitter account.

The model of analysis proposed by this study is reflected in the following equation:

$$CEDL = \beta_0 + \beta_1\, Firm\ Size + \beta_2\, Firm\ Profitability + \beta_3\, Firm\ Financial\ Leverage + \beta_4\, Energy\ Sector + \beta_5\, Board\ Size + \beta_6\, Board\ Gender\ Diversity + \beta_7\, Board\ Independence + \beta_8\, Audit\ Committee\ Size + \beta_9\, Number\ of\ Tweets + \beta_{10}\, Number\ of\ Followers + \varepsilon$$

4 Results and conclusions

Table 1 shows the descriptive statistics. The dependent variable of this study – *CEDL* – has an average value of 2.923. In relation to the independent variables, *Firm Size* shows an average value of 10.132. Furthermore, *Firm Profitability* has an average value equal to 24.330, while *Firm Financial Leverage* has an average value equal to 32.243. Table 1 also shows the results of the correlation analysis and the variance inflation factor (VIF) analysis which allow for the exclusion of multicollinearity issues.

Table 1 - Descriptive statistics, VIF and correlation analyses

	Variable	Mean	Std. dev.	VIF	1	2	3	4	5	6	7	8	9	10	11
1	*CEDL*	2.923	1.382	-	1										
2	*Firm Size*	10.132	0.986	1.97	0.107	1									
3	*Firm Profitability*	24.330	39.059	1.39	0.271***	-0.237***	1								
4	*Firm Financial Leverage*	32.243	12.320	1.46	0.399***	0.134	0.279***	1							
5	*Energy Sector*	0.404	0.492	1.36	-0.077	0.362***	-0.258***	0.188**	1						
6	*Board Size*	10.844	1.712	1.41	0.224***	0.441***	-0.193**	-0.007	0.135	1					
7	*Board Gender Diversity*	27.945	9.176	1.20	0.198**	0.223***	-0.151*	0.067	0.077	0.215**	1				
8	*Board Independence*	86.408	8.044	1.41	0.292***	0.275***	-0.179**	0.244***	0.022	0.333***	0.335***	1			
9	*Audit Committee Size*	4.638	1.091	1.09	-0.016	0.195**	-0.119	-0.043	0.048	0.203**	0.048	0.106	1		
10	*Number of Tweets*	5.351	1.751	1.82	0.802***	0.220***	0.139*	0.356***	0.088	0.223***	0.247***	0.231***	0.010	1	
11	*Number of Followers*	9.390	1.850	1.98	0.438***	0.470***	0.041	0.164*	0.022	0.214**	0.190**	0.210**	-0.025	0.570***	1

Notes: ***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

Table 2 instead shows the results of the linear regression analysis. The results obtained in the regression model almost totally support the hypotheses postulated in this study.

The results do not support hypothesis 1 (HP1). Indeed, they show a non-significant relationship between *Firm Size* and *CEDL*. In light of this, company size does not have a significant impact on the level of circular economy information disseminated by companies through their official Twitter accounts. In addition, the results support hypothesis 2 (HP2). Indeed, they show a positive and significant relationship between *Firm Profitability* and *CEDL*. In light of this, the most profitable companies tend to disclose a higher amount of circular economy information through their Twitter accounts. Finally, the results support hypothesis 3 (HP3). Indeed, they show a positive and significant relationship between *Firm Financial Leverage* and *CEDL*. In light of this, the most indebted companies tend to disseminate a higher amount of circular economy information through their Twitter accounts.

Table 2 - Regression model results

Variables	Coefficient	Standard error	p-value	Sign.
Cons	*-2.034*	*0.926*	*0.030*	**
Firm Size	-0.076	0.092	0.413	
Firm Profitability	0.005	0.002	0.018	**
Firm Financial Leverage	0.012	0.006	0.057	*
Energy Sector	-0.344	0.153	0.026	**
Board Size	0.079	0.045	0.081	*
Board Gender Diversity	-0.001	0.008	0.973	
Board Independence	0.019	0.010	0.047	**
Audit Committee Size	-0.023	0.062	0.708	
Number of Tweets	0.577	0.050	0.000	***
Number of Followers	-0.013	0.049	0.785	
N	141			
Adj. R^2	0.693			

Notes: ***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

This study aimed to investigate the drivers of the circular economy disclosure via Twitter. More in detail, this study investigated the effect of some characteristics of companies such as size, profitability and financial leverage on the level of circular economy information contained in the tweets published through the company official account. The results of this study showed that the most profitable and most indebted companies disclose a greater amount of circular economy information through their official Twitter accounts.

This study provides important contributions to the academic literature and practice. From an academic point of view, it first of all contributes to enriching the debate on disclosure policies relating to the circular economy which has become the object of interest of numerous scholars. Another important contribution is represented by the analysis of the factors capable of influencing the circular economy disclosure policies of companies. With reference to the practical contributions, this study first of all shows the need for certain types of companies to disclose circular economy information in order to mitigate the pressures to which they are exposed and satisfy the information needs of stakeholders. Furthermore, this study demonstrates the goodness of social networks and in particular of Twitter for the dissemination of circular economy information.

In conclusion, it is necessary to point out the limitations of this study. The main limitation concerns the focus of the econometric analysis on a single year. This limitation represents a starting point for future research. In fact, they will be able to extend the time horizon of the econometric analysis and allow the understanding of the evolution over time of the circular economy disclosure via Twitter.

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Exploring the Determinants of Consumers' Sustainable Fashion Purchase: An Integration of the Theory of Planned Behavior and the Fashion Adoption Theory

Valerio Schiaroli*

Sapienza University of Rome
Via Ariosto 25, 00185 – Rome (Italy)

Luca Fraccascia

Sapienza University of Rome
Via Ariosto 25, 00185 – Rome (Italy)
University of Twente
Drienerlolaan 5, 7522 NB – Enschede (The Netherlands)

Rosa Maria Dangelico

Politecnico di Bari
Via Edoardo Orabona, 4, 70126 - Bari (Italy)

** Corresponding author*

Abstract

Many fashion companies are increasing their sustainable offer by introducing into the market new sustainable clothing (e.g., bio-based garments). However, the level of acceptance of these products is still low among consumers due to barriers, such as high prices, lack of product knowledge or availability. To foster sustainable fashion consumption, a clear understanding of consumers' motivations to purchase this kind of clothing is needed.

This paper aims to investigate the determinants of consumers purchasing intentions and behaviors toward bio-based garments. To this aim, a conceptual framework was developed, based on the integration between the "Theory of Planned Behavior" (TPB) and the "Fashion Adoption Theory" (FAT). Sustainable fashion is considered a new trend, according to previous studies; therefore, the sustainable fashion adoption process was studied by reconducting the FAT variables in the TPB model.

This study adopts a quantitative methodology. A questionnaire was spread among Italian consumers. The linear regression technique will be used for data analysis.

The contributions of this study are manifold. From a theoretical point of view, the adoption of different behavioral theories and their modification using innovative and traditional

variables in different combinations. From a managerial point of view, (1) insights for developing marketing strategies for sustainable garments and specific consumer segments; and (2) information to evaluate how to best use digital channels to promote its sustainable offer. Concerning policy-related implications, this research will help define categories of target consumers on which to focus awareness campaigns.

Keywords – Sustainable fashion, Consumer behavior, Bio-based garment, Purchase behavior, Sustainable consumption.

Paper type – Academic Research Paper

1 Introduction

Nowadays, efforts are centered on shifting the fashion industry toward sustainability since this industry is responsible for high environmental impacts and contributes to climate change. Thereby, many fashion companies are investing in converting their production and their offer into more sustainable patterns. In this sense, biobased garments (e.g., Lyocell) represent a promising innovation. These garments are realized from biomasses, thus using natural materials averting the use of fossil ones.

However, the high prices, low consumer knowledge, and scarce availability prevent a wide diffusion and acceptance of these innovative sustainable garments into the fashion market (Harris et al., 2016). To help companies improve their sustainable offer and encourage consumers to choose this kind of product, understanding consumers' purchase motivation is critical (Apaolaza et al., 2022).

Scholars' attention to sustainable consumer behavior in the fashion industry is growing in recent years. Many studies are devoted to investigating consumers' purchase decisions toward sustainable garments (e.g., Amaral and Spers, 2022). Many theoretical approaches are used and the literature suggests extending existing theories (Dhir et al., 2021) using new variables (Park and Lin, 2020) and considering possible mediating, moderating or interaction effects among them (Pham et al., 2021). Studies focused on generic sustainable garments (e.g., Jacobs et al., 2018) or toward specific sustainable categories such as recycled (e.g., Nguyen et al., 2020) or organic (e.g., Thompson and Tong, 2016). However, studies on consumer purchase behavior for biobased garments are rare (e.g., Dangelico et al., 2022) and further investigations in this vein are needed

(Johnstone and Lindh, 2022). In addition, few studies investigate specific sustainable clothing items, such as t-shirts (e.g., Sonnenberg et al., 2014).

For the above-mentioned reasons, this study aims at investigating consumers' purchase behavior toward two specific items (i.e., underwear and jacket) of biobased garments. Underwear is associated with low visibility level and high skin contact, while the opposite is for jackets. The theoretical underpinning is based on merging the Theory of Planned Behavior (TPB) (Ajzen, 1985) and the Fashion Adoption Theory (FAT) (Sproles, 1974). The sustainable fashion adoption process was studied by reconducting the FAT variables in the TPB model. Finally, socio-demographic variables will be considered as control variables.

The paper is structured as follows. Section 2 presents the theoretical background. Section 3 presents the methodology. Section 4 presents the results. Section 5 presents the discussion and conclusions.

2 Theoretical background

2.1 Theoretical framework

The theoretical framework of this study is derived from two behavioral theories: (1) the TPB (Ajzen, 1985) and (2) the FAT (Sproles, 1974). These theories explain consumer behavior through motivational components and specific consumer traits.

TPB is a theoretical model that aims to predict human behavior, it is widely used in psychological, social, and marketing research (Kalafatis et al., 1999). Three main components compose the model namely: attitude (i.e., "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question"), subjective norms (i.e., "the perceived social pressure to perform or not to perform the behavior"), and perceived behavioral control (i.e., "the perceived ease or difficulty of performing the behavior") (Ajzen, 1991, p. 188). Many studies demonstrated the effectiveness of this theory in predicting consumers' behavioral intention toward sustainable products (e.g., Sreen et al., 2018; Yadav and Pathak, 2016). Concerning sustainable fashion, the TPB has been used to investigate consumer behavioral intentions, both with the original model (e.g., Iran et al., 2019) and through its extensions (e.g., Becker-Leifhold, 2018).

Fashion adoption concerns the individual decision-making process to adopt a new style (Kaiser, 1990). Sproles (1974) formulated a theory able to explain the

fashion adoption process. This includes consumers' psycho-graphic and motivation characteristics as adoption process influencing variables. Three main variables compose the model, namely: pre-existing conditions (i.e., consumer awareness and current level of acceptance of the product), directing influences on fashion decisions (i.e., psychological and social forces), and the central channel of consumer decision-making (i.e., actual evaluation and purchasing decision). FAT was employed in many studies investigating apparel purchasing behavior (e.g., Belleau et al., 2001). Concerning sustainable fashion, FAT was applied to study organic (Gam, 2011) and bamboo-made (Thompson and Tong, 2016) clothes.

This study integrates the TPB and FAT to build the research theoretical framework used to study sustainable fashion purchase behavior. Specifically, the attitudinal components are operationalized as environmental concern and fashion involvement; the social influence components as celebrities, influencers, and social media influence; the control components as product availability. Further, the role of knowledge is considered.

2.2 Hypothesis development

2.2.1 Environmental concern

Environmental concern (EC) can be defined as "the degree to which consumers are concerned about environmental problems and support efforts to solve them" (Dunlap and Jones, 2002, p. 485). Scholars consider it as a relevant predictor of customers' green purchasing (Testa et al., 2020) since it is a critical factor in the consumer decision-making process (Diamantopoulos et al., 2003). A high level of EC may be directly associated with a high level of purchase intention and willingness to pay for sustainable products (e.g., Joshi and Rahman, 2015). Several studies found the positive influence of EC on sustainable fashion purchases concerning diverse sustainable product categories, such as purchase intention toward organic (Yoo et al., 2013), second-hand (Cervellon et al., 2012), bio-based (Dangelico et al., 2022), and recycled (Park and Lin, 2020) garments; and willingness to pay for bio-based (Notaro and Paletto, 2021) and organic (Gam et al., 2010) garments.

Thus, it was hypothesized that:

> *(H1) Environmental concern positively influences the consumers' purchase intention and willingness to pay for biobased garments.*

2.2.2 Fashion interest

Fashion interest (FI) can be defined as the extent to which a consumer considers fashion clothing relevant to his/her tailor and creative self-expression of identity (O'cass, 2000). Fashion-involved consumers may adopt new styles earlier, driving and influencing the fashion adoption process (Chan and Wong, 2012). FI concerns consumers' attitudes and involvement toward fashion products and styles (Thompson and Tong, 2016) and was used in the literature to study the adoption of new fashion products (Gam, 2011).

Several scholars demonstrate that FI may positively affect PI for sustainable fashion garments (e.g., Hasbullah et al., 2022), such as second-hand (Kleinhückelkotten and Neitzke, 2019) and organic (Thompson and Tong, 2016) garments. Despite no studies highlighting the positive relationship between FI and willingness to pay for sustainable fashion products exist, since the effect of product involvement was found to be positive in literature (see e.g., Hwang et al., 2021; Rahman, 2018), it is reasonable to hypothesize that FI can influence the willingness to pay for sustainable garments.

Thus, it was hypothesized that:

> *(H2) Fashion interest positively influences the consumers' purchase intention and willingness to pay for biobased garments.*

2.2.3 Celebrities and Influencers

Nowadays companies embrace celebrities and influencers (CI) as brand ambassadors (Djafarova and Rushworth, 2017). Thereby, CI are able to influence the consumers' purchasing decision process, such as by intensifying consumers' purchase intention toward several product categories recommended (Meng et al., 2021) or the willingness to pay (Chung et al., 2013).

CI may enhance consumer acceptance of new fashion products by acting like fashion opinion leaders (Saleem et al., 2014). Thus, CI are social force able to influence consumer purchasing behaviors. The literature highlighted the positive impact of CI on consumers' purchase intention toward sustainable garments (e.g., Johnstone and Lindh, 2022). No studies investigate the impact of CI on consumers' willingness to pay for fashion garments. Nevertheless, previous research demonstrated the positive effect of CI on consumers' willingness to pay for sustainable products (e.g., Santos et al., 2019).

Thus, it was hypothesized that:

(H3) Celebrities and Influencers positively influence the consumers' purchase intention and willingness to pay for biobased garments.

2.2.4 Product availability

Product availability (PA) can be defined as the consumer's effortlessness in procuring the product (Chakraborty et al., 2022). Many studies highlighted barriers towards sustainable consumption, including the lack of PA (Peattie, 2010). Indeed, sustainable PA can encourage sustainable consumption (Ottman et al., 2006). The literature found a positive effect of PA on consumers' purchase intention toward green products (e.g., Tudu and Mishra, 2021; Walia et al., 2020).

Scholars found that consumers reported difficulty when finding sustainable garments in traditional stores and that only a limited range of sustainable garments with desired attributes is available (e.g., Wiederhold and Martinez, 2018). Sustainable product unavailability averts consumers from sustainable garments purchasing (Tran et al., 2022). Ho et al. (2020) included PA in the perceived behavioral control construct; their findings revealed that high PA is positively associated with high purchase intention toward sustainable garments. There are no studies investigating the impact of PA on consumers' willingness to pay for fashion products. Nevertheless, in other industries, it was demonstrated that PA might affect the willingness to pay a premium price (e.g., Osei Mensah et al., 2020).

Thus, it was hypothesized that:

(H4) Sustainable garments availability positively influences the consumers' purchase intention and willingness to pay for biobased garments.

2.2.5 Product knowledge

Product knowledge (PK) can be defined as the amount of information available in consumers' memory about product features and attributes (Philippe and Ngobo, 1999). Sustainable PK influences the consumers' purchasing goods decision-making process (Bernard et al., 2015). If consumers have scant knowledge of the product, their purchase intention is reduced (Maloney et al., 2014). PK reduces the risks associated with a good purchase as the consumer is aware of the quality and benefits of the product (Nekmahmud et al., 2022).

Scholars found that sustainable garment knowledge positively affects purchase intention toward sustainable garments (e.g., Frommeyer et al., 2022). Further, it

was found that subjective knowledge positively influences the willingness to pay for organic (Han, 2019) and biobased garments (Dangelico et al., 2022).

Thus, it was hypothesized that:

(H5) product knowledge positively influences purchase intention and willingness to pay for biobased garments.

2.2.6 Garment visibility and material used

Finally, the literature highlighted that consumer behavior might differ depending on the garment visibility and the specific material used (Dangelico et al., 2022). Thus, two clothing items were chosen as the study objectives, namely underwear and a jacket. These clothing items have opposite levels of visibility and skin contact.

Thus, it was hypothesized that:

(H6) consumer purchase behavior might differ based on the level of visibility and skin contact of the clothing items.

3 Methodology

To achieve the objectives of the study, a questionnaire was created. The scales used to define each variable included in the study are based on previous research (Table 1). The questions relating to the intention to purchase and the willingness to pay premium price were repeated for the two clothing items (i.e., underwear and jacket). The questionnaire was distributed in Italy through the snowballing technique. A final sample of 165 respondents was obtained. Statistical analyses were conducted using the SPSS 26 program. Firstly, a factor analysis was conducted using the principal component method, and all the scales used were found valid and satisfied test criteria. Secondly, a linear regression analysis was performed to test the hypothesis, one for each specific clothing item respectively.

Table 1 - Measurement items

Variable	**Reference**
Environmental Concern I am very concerned about the environment I would be willing to reduce or change my consumption to help protect the environment Protecting the natural environment increases my quality of life	D'Souza et al., 2015

Fashion Interest Fashion Clothing is a significant part of my life I am very interested in Fashion Clothing Fashion Clothing is important to me I would say Fashion Clothing is central to my identity as a person	O'cass, 2000
Celebrities and Influencers I follow various celebrities, bloggers and/or influencers online The relationship I have with a social media influencer (e.g. a celebrity or blogger) informs my fashion choices The ability to exchange information on fashion garments with a social media influencer is important to me I am more likely to buy a product if an online influencer reviews it positively Being part of an online community is important to me Connecting with people online who have similar values is important to me	Johnstone and Lindh, 2022
Product Availability Biobased garments are easily obtained in the market It is easy to find biobased garments It is easy to have access to biobased garments	Adapted from Singh and Verma, 2017
Product Knowledge I am very familiar with clothing made from biobased material I feel I know a lot about clothing made from biobased material I am an experienced user of clothing made from biobased material I would classify myself as an expert on biobased textiles	Adapted from O'cass, 2004
Purchase Intention I would consider buying underwear/jackets made from biobased material I am willing to purchase underwear/jackets made from biobased material There is a strong likelihood that I will buy underwear/jackets made from biobased material	Adapted from Sweeney et al., 1999
Willingness to pay How much more are you willing to pay for underwear/jackets made from biobased material compared to traditional garments?	Adapted from Dangelico et al., 2022

4 Results

Results of regression analysis show the following results.

Concerning *biobased underwear*, it was found that EC ($b=0.156$, $p<0.1$) and PK ($b=0.140$, $p<0.1$) have a positive effect on consumer purchase intention. In other words, the higher consumers are environmentally concerned and knowledgeable

about the product the higher their purchase intention. Conversely, PA (b= -0.151, p<0.1) has a negative effect on consumer purchase intention. The other variables (FI and CI) reported no significant effect. Regarding the effect on the consumers' willingness to pay a premium price, it was found that only EC (b=0.151, p<0.1) and PI (b=0.310, p<0.001) reported a positive effect. Environmentally concerned consumers willing to buy the product are willing to spend more on biobased underwear. The other variables were found to have no significant impact on the willingness to pay a premium price.

Concerning *biobased jackets*, it was found that only EC (b=0.243, p<0.01) has a positive effect on consumer purchase intention. In other words, the higher consumers are environmentally concerned the higher their purchase intention. Conversely, PA (b= -0.206, p<0.01) has a negative effect on consumer purchase intention. The other variables (FI, CI, and PK) reported no significant effect. Regarding the effect on the consumers' willingness to pay a premium price, it was found that only EC (b=0.147, p<0.1) and PI (b=0.222, p<0.01) reported a positive effect. Environmentally concerned consumers willing to buy the product are willing to spend more on biobased jackets. The other variables were found to have no significant impact on the willingness to pay a premium price.

Following the hypotheses discussion. H1 is fully supported, i.e., environmental concern has a positive impact on consumers' purchase intention and willingness to pay for both biobased garment categories. H2 and H3 were not supported, i.e., FI and CI do not affect consumer purchase behavior for biobased garments. H4 is not supported, i.e., PA impacts consumers' purchase behaviors toward both biobased garments categories, however, the effect is negative toward purchase intention and not significant toward the willingness to pay. H5 is partially supported, i.e., PK has a positive effect on consumers' purchase intention toward biobased underwear. However, the effect of PK on consumers' purchase intention toward biobased jackets and on willingness to pay for both biobased garments categories was found not significant. Finally, H6 is partially supported, i.e., for the purchase intention results show consumer behavior is different based on garment category (i.e., PK reported a positive effect for biobased underwear while not significant for biobased jackets). In other words, consumer behavior might differ based on the level of visibility and skin contact of the clothing items.

5 Discussion and Conclusions

This paper investigates the impact of several variables on sustainable fashion consumer purchase behavior toward two different items of biobased garments (i.e., underwear and jackets).

Several implications can be mentioned. From a theoretical point of view, this paper extends the TPB model through the FAT variables; this paper broadens the knowledge on new sustainable garments (i.e., biobased), considering and comparing two different clothing items. From a managerial point of view, this research provides insight for sustainable fashion marketers. For instance, it has been shown that accessibility does not have a positive impact on purchasing decisions. The diffusion of these products in the market does not seem to impact the purchase decision. In other words, the consumer does not buy biobased clothing because they are widespread, instead, he/she is willing to buy them regardless of their accessibility, a priori consumers start with the idea that he/she wants to buy them. In addition, it was demonstrated that PK might positively impact consumers' purchase intention. Companies should provide clear and reliable product information and spread them among consumers.

This study is not without limitations. The main limitation that should be acknowledged concerns the non representative sample of the Italian population.

Concerning future research direction, scholars could test the model in other contexts to compare the obtained results. Further, other clothing items and sustainable categories could be investigated in future studies. Finally, scholars should further investigate the role of PK in favor of sustainable fashion consumption behaviors.

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Villa Adriana as a Paradigm: The New Unesco Buffer Zone between Sustainability and Innovation

Valerio Tolve

Department of Architecture and Urban Studies
Politecnico di Milano
via Bonardi 3, Milano, Italy

Abstract

The 17 goals for sustainable development of the UN 2030 Agenda defines some of the main issues related to the environment, the climate change, the rational consumption of resources and the commitment to reduce inequalities between different countries and people themselves. Aspects whose solution today seems increasingly undeferrable: the succession of opposite climatic emergencies – for example from drought to floods – and the recent energy crisis impose a change of course with respect to the globalization trend that characterized the second half of the 20th century and the beginning of this new millennium, in the wake of mass production and consumption. However, the contemporary debate around these issues often suffers from the infodemic of our hyperconnected time and even more often from greenwashing practices. Even architecture, within its competence, must have the responsibility to really include these goals in its programs and conscientiously reconsider the use of resources, the choice of the best construction technique in relation to the theme and the context and the reduction of consumption of soil, towards a necessary rebalancing between nature and artifice, between construction and landscape.

This contribution wants to introduce some recent experiments conducted by a multidisciplinary research group who have attempted alternative approaches to the more consolidated ways of making cities and landscapes. *Learning from Villa Adriana*, is the project that offered us the opportunity to experiment these themes on a double layer: specifically, by investigating new forms for the re-signification of the Unesco Buffer Zone of Villa Adriana, and more generally by investigating tools for landscape management and cultural heritage with a view to truly sustainable development. This project was an opportunity to experiment new forms for the re-signification of Unesco Buffer Zone of Villa Adriana, re-establishing the ontological relationship between the Villa and its landscape – the *ager latialis* – removing it from the 'non-place' of the modern township to return it to the complex system of relationships between man and the environment. The project imagines a contemporary *locus amoenus*, extending from the Villa to the Aniene, which investigates the relationship between ancient/new and between nature/artifice. The landscape is the appointed tool for recomposing these antinomies within an overall design that redefines the terms of the necessary and sustainable transformation of a place.

Keywords – Cultural Landscape, Unesco Buffer Zone, Villa Adriana, UN 2030 Agenda

Paper type – Academic Research Paper



The Grand Villa Adriana. The new Unesco Buffer Zone. Masterplan

Learning from Villa Adriana, project by A. Bottelli, A. Raffa, V. Tolve, J. Mias, (Architecture; Politecnico di Milano; Universitat Politècnica de la Catalunya); P. Carafa, F. Slavazzi (Archaeology; Università degli Studi di Roma La Sapienza; Università degli Studi di Milano); RE/Lab (Urban planning and Transports); AG&P (Landscape); Astrapto (Lighting design). The project was awarded with an honorable mention in the *International Call for Design Projects "The Grande Villa Adriana. Designing the Unesco Buffer Zone"* (Accademia Adrianea di Architettura e Archeologia, Rome 2018) and won a special mention into "Technological green and receptivity" category at *EcoTech Green Award 2019* (Paysage Topscape, Padua 2019).

1 Locus amoenus

Quae nunc abibis in loca / Pallidula, rigida, nudula / Nec, ut soles, dabis iocos. This is how Hadrian addressed to his own soul at death's door. *Nec, ut soles, dabis iocos*. You will never have the usual distraction. Of which distraction does Hadrian

regret the imminent lack? It is widely assumed that the main reference is addressed to the Villa on Tivoli's slope. These words are the reasons of the birth and the lasting of the myth and fascination over the centuries of this place, that starting from Renaissance has become one of the unavoidable destination of every architect, artist or literate passing through Italy. The myth of Villa Adriana contains an unsolved dichotomy in the gap between reality and invention, between visible and conceivable. This gap has made possible that generations of architects would have imagined which were Hadrian's distractions with truthful or wrong reconstructions, result of a pursuit ideal world rather than the archeological reality.

In the past arriving in Villa Adriana from Rome meant leaving behind the city to enter the fields that separated the *Urbe* from Tivoli, populated by grazing flocks among ruins, in a sort of tridimensional arcadian landscape that raised the visitors' imagination and built the *locus amoenus* that had the Villa as the ideal terminal.

Nowadays the *ager latialis* is a dispersed landscape where the shapes of modern anthropized settlements, the shapes of nature and the shapes of archaeological ruins are compared in a small distance. The result is a landscape that is obviously different from the original, for the greater incidence of human settlement but above all for the substantial difference between the shapes of nature and those of artifice, no longer linked by a mutual relationship. So Villa Adriana's landscape it's a clear example: a palimpsest devoid of continuity where the great complex of the Imperial Villa is 'other' respect to its place and to the specific site's characters that defined its shape. Nowadays the original atmosphere is found only inside the Villa: outside – in its Buffer Zone – the difference between old/new switch from the dichotomy reality/invention to place/no-place. This project replaces the '*Grande Villa Adriana*' territory inside its own field, subtracting it from the spreading no-place, in order to give it back to the meanings place, that lives the relationships between human being and natural environment. A contemporary *locus amoenus*, that looks into the relationship between antiquity and contemporary without romantic sense, configuring a possible future where past and present are recomposing with continuity.

2 The 'Great Plan'

Addressing the project of the '*Grande Villa Adriana*' means thinking about the theme of the 'Great plan' which is such not so much for its territorial or geographical extension, but rather for the stubborn desire to find an overall compositional design – unitary but not totalizing – capable of bringing together again in a balanced compendium, nature and artifice. This is the greatest lesson that we can still draw also today from Villa Adriana: beyond the formal quality evoked by its ruins, its plan suggests that it's the settlement principle of architecture that defines the careful transformation of a place.

3 The new-order

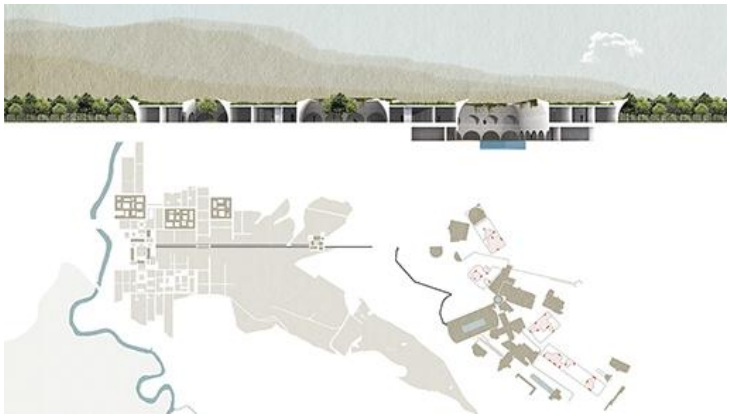
Two different layers, overlap and relating, rule the whole design proposal.

The first one, in the under-ground level, follows the direction of *via Maremmana*, that becomes an underground and distributional internal street. The second one, on the upper-ground level, derives from the existing directions of trees and the transverse east-west axis, that links the exedra of the '*Pantanello*' with the Travertine quarry beyond the Aniene river. This axis isn't only an infrastructure: it's a sequence of remarkable places that starts from Villa Adriana, it passes through the *Domus agricola*, the *Porta al Parco*, the *Commercial Hub* and the *Welcome Center*, it reaches the Travertine quarry, the Aniene and the renovated paths that lead to Villa d'Este.

The 'under-ground' layer and the 'upper-ground' one are strongly related, creating tension in the vertical section thanks to courtyards and holes that allow lighting and air diffusion inside the hypogeum spaces, as the roman architecture way.

All the architectures are inspired by the compositive and typological principles of Villa Adriana, applying the '*enclosure*' issue in its different morphological shape.

The *Parco* and *Orti adrianei* are the connective tissue of the project and they are developed from the Aniene bed to Villa Adriana, conceived as an unitary drawing that starts from the typical elements of this place: soil, orography and hydrography. Into this pattern are included the tracks of the new rivers, the renewed ground profile, the existing architectures or the new ones. The result is a delicate balance that describes the transformational action operated by human beings on nature.



The Grand Villa Adriana. The new Unesco Buffer Zone. Scheme and profile of the new Parco

4 The Architecture inside the Parco

Inside Hadrian's Garden a series of architectures is develop in sequence on an east-west axis which connects the Villa to the Aniene and, beyond the river, to the Travertine quarries, the place of production of the material with which the Villa itself is was originally built.

The *Hotels* and the *Congress center*, the *Commercial Hub* and the *Domus Agricola* rework and update the theme of the enclosure, identified as a constitutive element of the architecture of the Villa. The morpho-typological definition of the architecture is therefore inspired by the type of courtyard and enclosure: each architecture is conceived as an open courtyard, bounded by pavillions. The degree of openness of the enclosure, in favor of the park and the river, breaks the introverted character of the architecture and defines the physical and visual continuity between the different parts of the project. The same settlement principle of the architecture helps to rediscover a relationship with the Aniene – now denied by the modern settlements – and with the new cycle-pedestrian paths along its banks, up to Villa d'Este.

The *Porta al Parco* arises from the landscape as a landmark: a walkable architecture defined by two parallel walls, in which trapezoidal section are located the stairs that bring to the panoramical terrace. The internal walls are characterized by an articulated profile that follows the structural order of the brickwork. The walls surfaces in the external part of the building is treated as a huge storied plane, that anticipates the content of the exhibitions set up in the renewed Museum of the Villa and the activities program of the Park.

The *Reception center* is located besides the Aniene: this building, consisting of *Hotels and Convention center*, contributes in defining the shape of the project, in continuity with the greenery and building pattern.

The morpho-typological definition of architecture is inspired by the courtyard and the enclosure idea: every building is conceived as an open courtyard defined by the perimeter of the room pavillions and its service spaces. The disposition itself of the *Hotels* spanning the via Maremmana contributes to find a relationship with the river bed and the cycle and pedestrian paths. The five-stars hotel is placed near the Aniene, and it is provided with hypogeum baths and conference center, linked to the Commercial hub and the accommodation facilities.

The *Commercial Hub* has a strong relationship with the via Maremmana that goes underground, in order to favor the continuity of 'upper-ground' paths. Although the hypogeum complex of commercial and service facilities is placed in relationship with the street direction, the project rejects its settlement principle, getting in line the courtyard and shops spaces with the axis that guides the position of the parts: the morphological break within the two different directions is solved on the edges 'adapting' the pavilions shape in order to maintain the formal and geometrical precision of courtyards.

The Aniene has been chosen as the preferred view, so the project takes position against the modern and contemporary construction that takes the street as the main alignment, denying any relationship with the river, that becomes a forgot backside. On the contrary the project finds a different relationship with the Aniene, a natural infrastructure chosen to connect the Villa Adriana area with the Villa d'Este one. A cycle and pedestrian path along the river bed rules the sequence that links remarkable places, monumental or environmental ones, that are supposed to be requalified.

Beyond the river, the Travertine quarries are considered the park extension: they are places in which the compendium between nature and artifice is celebrated.

Along the east-west axis toward Villa Adriana, it's placed the complex of *Domus agricola*, conceived as a multiple courtyards building, in which the main *impluvium* rises as the core of the composition. Around of it the pavillion volumes and the working courtyard are located as a kind of quadrangular enclosure, defined by the pavillions perimeter and developed on two levels linked by the soil. The courtyard becomes the production but also the meeting place, with a theatrical effect, in which is celebrated the *mise en scène* of work. At the lower

level are placed the productive functions and the managing office of *Domus* (olive-press; store room for equipment and machines; warehouses for products, conceived as a showpiece, open to the public). The upper level houses educational functions and the manufacturing sector training (kitchen laboratory with restaurant, tasting area and shop, multiple function pavillions for exhibitions and presentations).

Inside the *Parco*, the design proposal tries to satisfy not only the traditional aesthetical and agronomical requirements, but also the environmental compatibility ones, choosing the species on account of their carbon dioxide and gaseous pollutants absorbing capability. The landscape project has been developed following some criteria:

- analysis of the local flora features (as in the very close area as in the bigger setting), soil features, its settlement, exposition and medium, maximum, minimum temperatures;
- the necessity to consider the presence of plants and farming systems able to low down excessive levels of soil lead by foliar metabolism, with the collection of the dry substance and the root one (phitoremediation and phytostabilization fenomena);
- the consideration of the existing track of the local crops, such as olive grove;
- recalling the Hadrian's explored and lived landscapes in the plants choice (even for educational purposes), avoiding the introduction of exotic species that don't belong to the Tivoli area (it's an easy operation, as the majority of the local plants, trees and shrubs come from the Mediterranean and Asia Minor basins where Hadrian lived for a long time);
- the creation of an environmental and multifunctional communion, employing low maintenance impact and limited water consumption vegetale essences and farming systems;
- the creation of agricoltural production settlement and nutritional plants (fruit, vegetable and essences) aimed to be sold and manifactured in the *Domus Agricola* itself;
- the attempt to support the reading and the characterization of places through plants, using them along paths as rows (orientation), on buildings rooftop (insertion in the built environment), as rows and cultivated lots (producting evocation), such as flowerbeds in the

courtyard, arrival and break areas, in the orchard and in the olive grove (ornamental value) or as green perimetral Buffer Zone and camuflage towards the nearby area (fitler function). The project of the external arrangement, that completes the overall proposal, is articulated in five different landscape unities.

Green rooftops. For a better environmental settlement and for minimizing the low-rise building impact (commercial centre, hotels) it was thought to introduce green rooftops, applying the most recent techniques: small section composition with efficient drainage, a minimal growing medium and precutlivated plants carpet of mediterranean species: *Lippia nodiflora*, *Mesembriantemum*, *Delospernum* and *Sedum* mix, completing the camuflage effect with *Rosmarinus prostratus* falling from the top along some walls.

Courtyard gardens. The connective pattern around the built environment and the several closed cloisters that are placed in the core of buildings are characterised by little and lush gardens of perennial plants and ornamental mediterranean bushes (*Plumbago spp.*, *Rosmarini*, *Lavande*, *Mirti*, *Teucrium fruticans*, *Escallonia myrtifolia spp.*, *Convolvoli*, *Oleandri*, *Osmanthus spp.*, *Solanum spp.*, *Agapanti*, *Iris*, *Artemisia*, *Strelizie spp..,* ecc..), little pomegranates, citrus trees and strawberry trees. Water completes spaces with little pools and fountains, that quotes features of the archaeological area. The filtered water will be managed with recovering and recycling systems.

The orchards and the gardens. Beyond the *Porta al Parco*, on both sides of the path that brings to the *Villa*, nearby the *Domus agricola*, there are fields partially characterized by olive grove. In these areas it was supposed the introduction of a huge orchard that follow the tracks and the distances of olive trees, completing the scenery with suitable other olive trees species and new citrus tree rows (*Lemons*, *Oranges*, *Kumquat* and *Grapefruits*), *Pomegranates, Figs, Almond, Apricot e Peach trees*. In the more sunny areas inside the orchard there will be little garden fields of aromatic and medicinal plants (*Rosmary, Lavander, Borag, Savory, Artemisia, Balm, Oregano, Thyme, Vervain, Myrtus tarentina ecc…*) instead of vegetables (too expansive managing); other little fields will be characterized by perennial rustic ornamental plants (*Perowskia atriplicifolia, Gaura lindhmeri spp., Verbena bonariensis, Cistus spp.. Teucrium, Polygala myrtifolia, Echinacea spp., Rudbeckia spp., Salvia nemorosa, Lytrhum spicata, ecc…*). Among the rustic ornamental plants that will be part of the little flowering field, there will be some species able to fix the soil lead in the roots, avoiding its transmission to the air

parts and leaves, such as *Heather*, *Cystus*, *Genistas* and *Hipericum*. All the fruits and medicinal plants will be harvested, transformed and manifactured to be sold directly with the *Domus Agricola* logo. The perennial plants and ornamental shrubs will be an aesthetic recall and they will be placed along secondary paths that lead – from the main path with different perspectives – to the archaeological site toward the new agricultural area.

Rows along paths. The main path will be characterized by a Cypress row on the downstream side. The higher plants, already existing along other paths of the archaeological site, will guide visitors toward the destination. Rows inside the orchards will do the same with secondary places. Along the main path a water canal will mark the row track as linking *fil rouge* between the Buffer Zone and the archaeological site.

The perimetral of Unesco Buffer Zone. The Buffer Zone, as the wide area that divides the archaeological site core, presents boarding areas that in some cases need greenery strips with visual and acoustic filter function, but always with a landscape settlement function. These strips, especially the planted ones, will be differently composed and will introduce local plants with good lead bioaccumulation properties (in particular *Poplars* and *Willows*). In some cases the planted strips will include local shrubs *Stawberry trees, Myrtels, wild roses beds, Prunus*, *Genistas* as well as shrubs and perennial plants with good lead bioaccumulation proprieties as *Cystus* and *Silene*.



Hadrian's Garden. The new Landscape

5 The Architecture inside the Villa

At the end of the axis, from the exedra of the *Pantanello*, a new path inside the Villa begins, reactivates a part of the ancient monumental entrance through the *Grande Vestibolo*: from the *Cento Camerelle* it can reach the *Canopo* and the *Antiquarium* through the network of existing underground paths, re-opened to the public and set up.

Having recognized the methods of construction of the architecture of the Villa, for terraces and substructures, the project operates by additions in continuity with them. Thus the recovery of the *Antiquarium* is articulated on both levels of the original building: the lower one are new exhibition spaces for the Museum in the evocative vaulted architecture, while the upper level, overlooking the *Canopo*' valley, host the studios, having the largest spaces of the Casino and the possibility of building new pavilions on the remains of the cells, whose punctual sequence of views becomes a loggia towards the *Canopo*. The architecture of this new building takes the ancient idea to take the opportunity of the collapse of architecture in order to present a variation. The punctual sequence of the views becomes a continuous loggia with a vaulted ceiling that looks toward the *Canopo* and the *Grande Vestibolo*. The loggia is also the distribution element to the new exhibition rooms, conceived as the extensions of the ancient cells along the terrace depth. All this spaces are covered by an unique roof, which section, in its different relationship between the intrados and extrados, discloses the continuity and the transformation: the part of the building facing the *Canopo* and the *Grande Vestibolo* follows the pitched roof, whereas the rooms extended along the depth toward the terrace at a first sight are pure shaped volumes externally, contrasting with the evocation of vaulted ceiling of the cells internally.

The internal exhibition is well-finished and polished, trying to follow the spirit and the lesson of Italian museography through the attention toward the coexisting relationship between place, object and exhibit medium.

From the *Antiquarium* complex are developed two different paths toward different direction: one reaches the *Roccabruna* area, the other one passing the *Pretorio* terrace where the *Archeological Village* is located: it is composed by laboratories for archeological excavation, guest houses, studying spaces.

The necessity of new addictions as grafts that are directly introduced in the architectural composition of the Villa is the main topic subtended in this part of the project. So our proposal reflects on the generative features of the place

starting from its founding character and on the constructive way of architectures of the Villa, that is always looking for relationships with the orography and the artifice.



The Grand Villa Adriana. The archaeological village

The *Library* and the *Hall* are the core of the educational center, conceived on the tracks of *Plutonium*. The project arises on a platform that today is largely set in the ground. It consists in rebuilding a part of the temple, that exists as a ruin at the opposite side. In this way the ruins on one side and the finished shape of the new volume on the other one - that follows the original idea of the court yard - face each other on the central void. The hypogeum level, partially uncovered, is requalified for exhibition activities, linked to the visiting itinerary of the Villa and to educational activities placed into the new building.

Just over, behind the *Bocca degli Inferi*, there is the guest house: it arises on the top of the *Muro delle Fontane* that starts form the *Accademia*. This way of approaching to ruins is directly assumed from the building principle of the Villa. In this way the ancient wall becomes the building substructure: the guest house is developed along the longitudinal axis on the wall. The architecture presents a

double loggia: the first one, toward the valley, faces the Villa and it is the distribution to the four blocks of the rooms; the second one, upstream, faces the *Accademia* terrace.

The needing of new volumes for *Laboratori di scavo* doesn't mean adding a new direction in the Villa composition, rather than establish an excavation grid in which they are included. It has been assumed an 'Archeological excavations plan', locating four different studying areas that have been defined with a perimeter and a settlement. The first area sets alongside the *Pretorio*' terrace; the second one includes the *Macchiozzo*, the third one is located on the top of the terrace under the *Library* yard; the last one matches the supposed '*Hippodrome-Stadium*' drawn by Piranesi close to the *Pantanello*, that could be connected to the marble model found in the *Grandi Terme*. In this area we have been choosen three focusing points, that it is possible to develop in sequence and according to the archaeological findings. In this proposal the *Laboratories* are conceived as punctual and modular structures matching the excavations plan, as *en plein air* pavillions that define and equipe the perimeter. They are open to the view and show the archaeological activities. The new volumes of the *Archaeological village* are simple shaped as pure volumes, inspired by the ruins. They are conceived with low prefab technology, with steel or wood structure and hardwood pannel coating. The construction is intended in the classical sense: a strongly expressive action toward the 'exact construction' in which architectural shape, built shape and materials are involved.

Finding the new *Grande Villa Adriana*.

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Supporting Decision Making in Waste Management Companies: Using AHP Methodology to Assess the Optimal Scenario for Disposable Diapers Collection

Natalia Marzia Gusmerotti*

Department of Management and Law
University of Rome Tor Vergata,
Via Columbia 2, 00133 Rome, Italy

Filippo Corsini

Institute of Management
Sant'Anna School of Advanced Studies
Piazza Martiri della Libertà, 24, 56127, Pisa, Italy

Serena Carlesi

Lucart Group,
Via Ciarpi, 77, 55016, Porcari (LU), Italy

Marco Frey

Institute of Management
Sant'Anna School of Advanced Studies
Piazza Martiri della Libertà, 24, 56127, Pisa, Italy

Andrea Appolloni

Department of Management and Law
University of Rome Tor Vergata,
Via Columbia 2, 00133 Rome, Italy

** Corresponding author*

Abstract

Waste collection and recycling processes represents a strategic activity in supporting the circular transition. The present research deals with disposable diapers collection; indeed, in order to increase the recycling rates of such typologies of waste, during the very recent years, waste management companies initiated to collect those separately from other household waste streams with different typology of collections.

Making use of a case study grounded on raw data from six municipalities within Lucca province (Italy), our research aims at assessing, using an Analytic Hierarchic Process (AHP), six possible scenarios for used disposable diapers collection.
Results shows that the best scenario is represented by the one where disposable diapers are collected from users by a curbside door-to-door collection system on a weekly base. Results are discussed under a managerial perspective in order to support future decision-making processes in waste management companies.

Keywords - Circular economy, Business model innovation, , Waste management, Decision Making and AHP methodology

1 Introduction

The linear take-make-dispose economic system, perpetuated for decades, generated two gigantic matters; on the one hand, the scarcity of natural resources, while on the other, a huge waste generation. In the very last years, the vision in redesign processes to reduce the use of natural resources and minimize the environmental impacts by incrementing product recycling brought to the formulation of a new paradigm called circular economy (Ellen MacArthur Foundation, 2013).

The idea behind the circular economy model is to involve as much as it is possible of the existing material capacity in economic systems into efficient use (Korhonen et al., 2018). In order to obtain such a goal, waste collection and recycling processes certainly represent a strategic aspect.

The European Union, in order to increase recycling rates, issued several policies and regulations. The Extended Producer Responsibility (EPR), which aims at making producers responsible for organizing and paying the treatment of their products reaching the end of the life cycle, is certainly an example of the EU's effort in increasing collection and recycling rates (Corsini et al., 2017). According to the most recent data, in the European Union (EU28) in the recycling rates of municipal waste largely increased raising from 35% in 2007 up to 46.4% in 2017 (EUROSTAT, 2018). However, in order to switch European global economy to a more circular one still much effort is needed. Within this context, there are some products that, according to the new consumption patterns, started to become crucial under a collection and recycling point of view. Disposable diapers are surely a typology of product that demands consideration (Colón et al., 2011; Mendoza et al., 2019) as the consumption trends are firmly rising. In most of European countries the reduction of birth rate slightly hindered such market

while, on the other hand, the consumption of disposable diapers for elderly people climbed as life expectancy largely increased (Inkwood Research, 2018). For instance, in Italy, the National Institute of Statistics (Istat, 2019), in computing the annual index representing the basket of consumer goods for the year 2019, for the first-time added diapers for elderly people.

Considering such trends, more research is therefore needed to address the end of life of such products. Our research deals specifically with disposable diapers collection; the reason for such a choice is related to the fact that, to increase the recycling rates of such typologies of waste, during very recent years, waste management collection companies initiated to collect those separately from other household waste streams with some ad-hoc collection (Pires et al., 2019). Waste management companies, indeed, introduced several typologies of collection strategies ranging, for example, from setting collection points accessible for the inhabitants to arranging a scheduled door to door collection. So far, to our knowledge, no one has deeply evaluated the ways of conducting diaper collection under an economical, technological and socio-environmental perspective.

With our research, we aim to fill this gap in the literature using a multicriteria decision making approach to evaluate six possible scenarios for disposable diaper collection. Our research deals specifically with the disposable diapers collection; the reason of such choice is related to the fact that, in order to increase the recycling rates of such typologies of waste, during the very recent years, waste management collection companies initiated to collect those separately from other household waste streams with some sort of ad-hoc collection (Pires et al., 2019). Waste management companies, indeed, introduced several typologies of collection strategies ranging for example from setting collection points accessible for the inhabitants to arranging a scheduled door to door collection. So far, to our knowledge, no one deeply investigated and evaluated the ways of conducting diapers collection under an economical, technological and socio-environmental perspective.

In detail, the model for assessing the scenarios was grounded on raw data from six municipalities in Tuscany region (Italy). In this area, Ascit, a waste management company, is in charge of the waste management collection (Altopascio, Porcari, Capannori, Montecarlo, Pescaglia and Villa Basilica). The area covers approximately 325 square kilometres with an estimated population of 79,398 inhabitants (ISTAT, 2018) and a production of municipal solid waste of 463.5 kg

per inhabitant per year (Ascit, 2017). More specifically, 25-30% of municipal residual waste comprises diapers products equal to 2,200 tons/year (Ascit, 2017).

To investigate the most suitable way for managing the collection of diapers, we selected potential alternatives (i.e. Scenarios) after an in-depth analysis of the literature regarding similar studies on diaper waste management (Arena et al., 2016; Kim & Kim, 2018) and structured interviews with seven different Italian waste management operators with a post-consumer diaper collection service.

The rest of the study is structured as follows. In section 2, we describe the scenarios under investigation, the data collection processes and the methodologies used. In section 3, we present the results obtained and the sensibility analysis conducted. Finally, the last section provides the main conclusions, as well as a discussion of their implications, limitations and ways forward in further studies.

2 Materials and Methods

2.1. Data Collection

The model for assessing the scenarios was grounded on raw data from six municipalities within Lucca province, in the Tuscany region (Italy). In this area Ascit, a waste management company, is in charge of the waste management collection (Altopascio, Porcari, Capannori, Montecarlo, Pescaglia and Villa Basilica). The area, covers approximately 325 square kilometres with an estimated population of 79,398 inhabitants (ISTAT, 2018) and a production of municipal solid waste of 463.5 kg per inhabitants per year (Ascit, 2017).

The data on generated baby and adult diaper waste were taken from the technical output of Ascit: 25-30% of municipal residual waste is made up of absorbent hygiene products (Ascit, 2017). Referring to this percentage, Ascit estimated a diaper waste production of 2,200 ton/year (Ascit, 2017).



Fig. 1 Ascit area (LU - Italy) and waste collection centers located within it

With regard to the waste collection, within the area under investigation, the most common types of municipal waste (residual waste, organic and yard, paper and cardboard, glass, plastic, tin) are placed in special color-coded bins that are readily available, free of charge and collected door-to-door. curbside door-to-door collection is supplemented by Waste Collection Centers (WCCs): centers equipped with bins for other types of urban waste, from aggregates to bulk, from electrical and electronic appliances to hazardous waste. Within the area under investigation there are six WCCs (Fig. 1), five located in the municipality of Capannori (Salanetti 1, Salenetti 2, Colle di Compito, Lammari and Coselli) and only one in the municipality of Pescaglia (Piegaio). All this has produced a recycling rate of 72,9% (Ascit, 2017), a better performance than those referred to Tuscany region (53.1%) and Italy (55.5%) (ISPRA, 2018).

2.2 Scenarios

In order to investigate the most suitable way for managing the collection of diapers we selected the potential alternatives, after an in-depth analysis of the literature regarding similar studies on diaper waste management (Nicki Souter Associates, 2013; Arena et al., 2016; Kyung-Shin Kim et al., 2018) and structured interviews with seven different Italian waste management operators, presented in Fig. 2, with a post-consumer diaper collection service. So, six alternatives with respect to the delineation of the best scenario for baby and adult diaper waste

collection in municipal solid waste management, were delineated and assessed by our research.

Italian region	Waste Operator		Municipalities with diaper waste collection service (n.)	Inhabitants In 2017 (ISTAT 2018)
Veneto		CONTARINA S.p.a.	50	554.000
		PONTESERVIZI srl	1	8.520
Tuscany		GEA Garfagnana Energia Ambiente srl	15	26.526
		REA Rosignano Energia Ambiente S.p.a.	1	2.342
		Alia S.p.A.	10	311.105
Sardinia		Ambiente 2.0 Consorzio Stabile S.c.a.r.l.	1	22.335
		Consorzio Formula Ambiente Soc. Coop. Soc	1	31.653



Fig. 2 Italian waste operators interviewed for this project

The system boundaries for all alternatives exclusively include the collection of post-consumer diapers from private homes to the waste collection center/waste transfer station.

The first alternative (Scenario 1) is represented by a scenario where consumers individually transport the used diapers to the WCC. We assumed the exploitation of only one waste collection center.

The second alternative (Scenario 2) is represented by a scenario where used diapers are collected by a curbside door-to-door collection system with a weekly based collection frequency. Purple semi-transparent sacks are provided to participants. In this case, the diaper waste system includes the creation of a specific waste transfer station within the WCC. Also, in this case, we assumed the exploitation of only one waste collection center.

The third alternative (Scenario 3) is represented by a scenario where used diapers are collected by a curbside door-to-door collection system with a weekly based collection frequency, exactly as planned for scenario 2. Purple semi-transparent sacks are provided to participants and a waste transfer station within the WCC is realized. Unlike Scenario 2, in Scenario 3 participants have to call for the diaper waste collection service by means of their phone: a specific call-center service is planned along with the development of a specific planning software to plan the diaper waste collection. This calling stage is mandatory to collect post-

consumer diapers. We assumed the exploitation of only one waste collection center.

Finally, three different hybrid alternatives have been elaborated: Hybrid Scenario A, Hybrid Scenario B and Hybrid Scenario C.

Hybrid Scenario A is represented by a scenario where Scenarios 1 and 2 are combined: the collection of post-consumer diapers is carried out by WCC and door-to-door waste collection.

Hybrid Scenario B is represented by the combination of Scenarios 1 and 3: the collection of post-consumer diapers is carried out by WCC and a door-to-door collection after consumers' request.

Hybrid Scenario C is represented by the combination of Scenarios 2 and 3: the door-to-door collection of used diapers is carried out by means of consumers' request along with a collection in a prefixed day. All scenarios are fully described by Fig. 3.

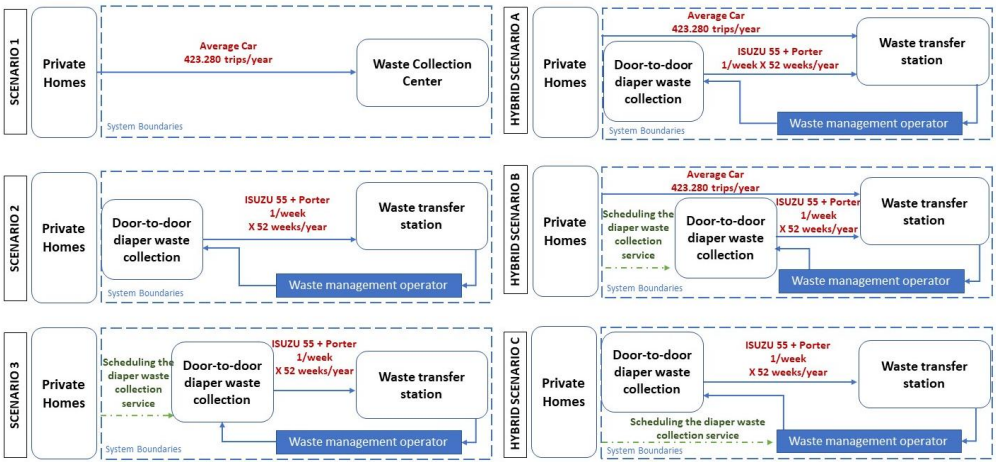

Fig. 3 System boundaries and scenarios presentation

2.3 Criteria

In order to evaluate the six scenarios presented above we selected several criteria and sub-criteria for after an in-depth analysis of the literature regarding similar studies on waste management scenarios (Bello-Dambatta et al., 2009; Nicki Souter Associates, 2013; Milutinović et al., 2014; Babalola, 2015; Gusmerotti et al., 2018). More in detail, after having selected all the relevant literature and having discussed with the waste management operator, a worksheet was

designed in order to collect the most useful criteria used in similar evaluations. Then, each of the criteria was read independently and iteratively discussed by the researchers involved in the project, thereby ensuring reliability through consensus and minimization of bias. Through this process, useless criteria were rejected, reaching a final number of 7 criteria. Those are: economic criteria (i.e. capital costs and operational costs), technical criteria (i.e. adaptability, training and user preference) and social-environmental criteria (GHG emissions in CO_2 equivalents and job creation). The following paragraphs give a short presentation of the chosen indicators.

2.3.1 Economic criteria

Economic evaluation is a significant part of tactical planning and investment programming for any waste collection management system. Estimating the preliminary investment capital requires long-term operating and maintenance costs in relation to the different expected/planned waste management activities. We addressed economic aspects through capital and operational costs related to the diaper waste management activities planned by each of six scenarios. Those costs are frequently considered for evaluating alternatives in multi-criteria studies (Bello-Dambatta et al., 2009; Milutinović et al., 2014; Babalola, 2015; Pabule et al. 2015; Yap and Nixon, 2015; Gusmerotti et al., 2018).

The capital cost represents the amount required to construct the new diaper waste management infrastructures and facilities. For evaluating the investment costs, land costs, the costs of design and construction of waste facilities, the transportation/collection vehicles costs, equipment costs and staff training costs were all considered. More in detail, for the assessment of the Scenario 1, the purchase of a roll-off dumpster for the WCC was considered with the exclusion of the costs related to new waste collection vehicles. We assumed that consumers individually transport their own used diapers to the WCC. On the contrary, for the assessment of Scenario 2 and Scenario 3 we took into account the capital costs of the purchase of new waste collection vehicles (i.e. one PORTER Euro 6-GPL up to 2.2 ton and one ISUZU Euro 6-diesel up to 5.5 ton). For all six scenarios the capital costs related to staff training were added. Details of capital costs are presented in Table 1.

Operational costs in details include: supply chain costs (i.e. purchase and use of semi-transparent purple sacks), staff costs and cost of vehicles maintenance (e.g. energy, fuel, etc.). For the assessment of Scenario 1 we assumed that no waste

collection vehicle is used. So, the cost of vehicle maintenance was not taken into account. On the contrary, this operational cost was added for the evaluation of Scenario 2 and Scenario 3. For the assessment of Scenario 2 and Scenario 3, also costs related to the purchase and use of semi-transparent purple sacks for post-consumer diapers were taken into account (i.e. supply chain costs). For all six scenarios the operational costs related to staff were taken into account. Details of operational costs are displayed in Table 2.

Table 1 Details of capital costs in €/ton per year

	Scenario 1	**Scenario 2**	**Scenario 3**	**Hybrid Scenario A**	**Hybrid Scenario B**	**Hybrid Scenario C**
Land costs, design and construction of new infrastructures	1.36	1.36	1.36	2.52	2.52	1.36
Equipment	0.14	0	0	0.14	0.14	0
Vehicles	0	11.25	11.25	9.57	9.57	11.25
Staff training	0.45	2.28	3.64	2.38	3.54	2.96
Total capital costs	1.95	14.89	16.25	14.61	15.77	15.57

Table 2 Details of operational costs in €/ton per year

	Scenario 1	**Scenario 2**	**Scenario 3**	**Hybrid Scenario A**	**Hybrid Scenario B**	**Hybrid Scenario C**
Supply chain costs	0	7.04	7.04	5.98	5.98	7.04
Staff costs	3.75	18.80	13.16	22.55	16.91	25.38
Cost of waste collection vehicles	0	8.38	5.03	8.38	5.03	10.89
Total operational costs	3.75	34.22	25.23	36.91	27.92	43.31

Finally, the economic criteria measured in €/ton per year for each scenario are presented in Table 3.

Table 3 Economic criteria for each scenario

	Scenario 1	Scenario 2	Scenario 3	Hybrid Scenario A	Hybrid Scenario B	Hybrid Scenario C
Total capital costs (€/ton year)	1.95	14.89	16.25	14.61	15.77	15.57
Total operational costs (€/ton year)	3.75	34.22	25.23	36.91	27.92	43.31

2.3.2 Technical criteria

Technical criteria are particularly valuable when selecting waste collection options. Their importance is usually in view of the possibility of subsequent increases in the daily tonnage of waste that the facility will be required to manage, for added processing capabilities. These criteria also determine what equipment and training will be necessary to perform the waste management responsibilities.

First, this study considered the adaptability and the need of specific training for each scenario.

The adaptability regards the adaptability of the new scenario to existing waste management systems, whereas the training is related to the users of diaper waste collection service. This latter represents the user's ability to manage with new waste collection systems.

We assessed both criteria qualitatively using the 9-level scale (1 - Worst, 9 - Best) established by Saaty (Saaty, 1980). Three experts in the waste management field were involved for the assessment of these sub-criteria.

Among the technical criteria, we also included user preference, which is crucial to develop a new waste collection system. This sub-criterion represents the public acceptance. Public awareness, indeed, positively and negatively can influence people's approach to waste management and consequently, even the success for a new waste collection management system (Milutinović et al., 2014). In order to assess user preferences we developed a questionnaire that was administered in the period May 2018 - September 2018 in the area of the study. The questionnaire was sent via email, after being uploaded on a web platform, only to the users of baby and adult diapers contacted with the help of the waste management company. Reminders were sent every 15 days. As Tourangeau & Yan (2007) underline, social desirability represents the most common bias

affecting the validity of a questionnaire especially if dealing with such a sensible issue. This risk was, therefore, overcome by guaranteeing the anonymity of the respondents.

The questionnaire was structured to capture the general information about the respondents (e.g. age, sex, number of family members, etc.), the average amount of diapers used in a monthly time frame, the preference with respect of the 6 scenarios for diapers collection (Appendix A). The preference measurement over the 6 scenarios was performed with a 5-point Likert scale (Likert, 1932). A total of 147 responses were received and used in the subsequent analysis.

Table 4 Technical criteria for each scenario

	Scenario 1	**Scenario 2**	**Scenario 3**	**Hybrid Scenario A**	**Hybrid Scenario B**	**Hybrid Scenario C**
Adaptability (%)	8.9	39.9	10.7	14.7	9.0	16.9
Training (%)	17.0	9.8	11.9	29.2	25.1	7.0
User preference (weighted average survey answers)	1.74	4.44	2.91	3.83	2.87	4.13

2.3.3 Social-environmental criteria

We assessed the social-environmental aspects through two criteria: GHG emissions in CO_2 equivalent and job creation.

GHG emissions are one of the criteria used by the European Environmental Agency to measure the performance of municipal waste management in 32 countries (EEA, 2013). Similar criteria, including GHG emissions or pollutant emissions in general, are considered in many multi-criteria studies (El Hanandeh et al., 2010; Roussat et al., 2009).

We calculated emissions – on the basis of literature (Mckinnon et al., 2010; DEFRA, 2017) and technical outputs of the waste management operator. In our assessment of GHG emissions in CO_2 equivalents, we considered as boundaries of the system the point at which the used diaper is discarded by consumers into the waste stream up to the point at which it is collected/stored in the waste collection center/waste transfer station, according to Fig. XX. In detail, the measurement of GHG emissions in CO_2 equivalents took into account the transportation of diaper waste and the electric consumption of waste facilities, weighted on the diaper waste tons estimated per year. As regards conversion factors we used conversion

factors elaborated by the Department for Business, Energy & Industrial Strategy of UK government (DEFRA, 2017).

Among the social-environmental criteria, we also included social sustainability. Social sustainability in waste management means the ethical behavior of the waste management system towards society (social acceptability, social equity and social function) (Gusmerotti et al., 2018; Den Boer et al., 2007). The social function (i.e. the benefit of the waste management system) can be measured through the employment rate (Gusmerotti et al., 2018; Den Boer et al., 2007). The level of employment in waste management, in terms of tons of waste per job, appears to vary significantly between different activities. Although there are some inconsistences in the data, there is general agreement that the most labor-intensive activities (<500 tons of waste per job) are manual sorting, some separate collection process and waste and scrap wholesale. The least labor-intensive activities (over 1,000 tons of waste per job) are landfill, incineration and composting together with most forms of collection (Risk & Policy Analysts Limited, 2001). In view of the fact each scenario describes a specific diapers waste collection system, we elaborated the employment rate on the basis of the different collection activities planned by each of them, considering only the actual workforce needed for these waste collection services. The number of jobs for each scenario is presented in Table 5.

Table 5 Social-environmental criteria for each scenario

	Scenario 1	**Scenario 2**	**Scenario 3**	**Hybrid Scenario A**	**Hybrid Scenario B**	**Hybrid Scenario C**
GHG emissions (kilograms of CO_2 equivalents for each ton of waste managed/year)	207.84	2.77	2.77	227.86	227.86	4.08
Job creation (n.)	0.2	1	1.5	1.2	1.7	1.8

2.4 AHP methodology

The Analytical Hierarchy Process - AHP, developed by Saaty (Saaty, 1980), allows dividing the decision problems into understandable parts; each of these parts is analyzed separately and integrated in a logical manner. It is a comprehensive methodology designed to facilitate the decision-making process by using both empirical data and subjective judgments, allowing to derive a scale

of priorities that are valid to make complex decisions. Such method has been used for solving complex decision-making problems in various disciplines and currently is widely used in the field of waste management (Soltani et al., 2015).

According to the axioms on which the AHP methodology is based (Vargas, 1990), we structured the goal of delineation of the best scenario for collection of post-consumer diapers in four levels. In detail, we structured the decision hierarchy according to the goal in the following order: the objectives from a broad perspective, through the intermediate levels (criteria on which subsequent elements depend) up to the lowest level (a set of alternatives). According to Fig. 4, the hierarchical structure of the decision-making consists of following levels: the first level represents the ultimate goal of the decision hierarchy (assessing the best used diapers collection scenario), the second level introduces the criteria, the third level shows the sub-criteria that are utilized in this work and finally the fourth level shows the alternatives.

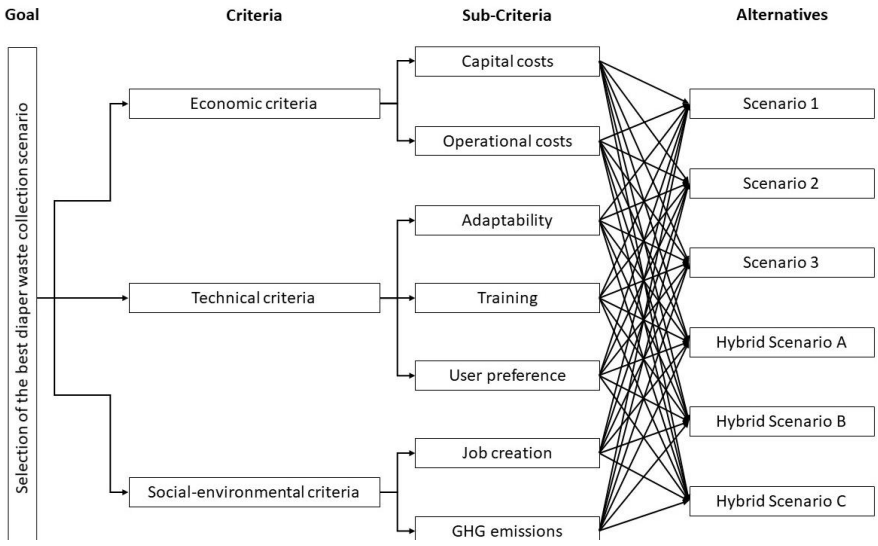

Fig. 4 Hierarchical structure for the selection and evaluation of a sustainable waste management scenario

3 Results

3.1 Criteria ranking

The AHP methodology implies to broke down the judgment into series of pair comparison matrices, where the experts are required to evaluate the importance of each criterion with respect to the established goal. As rule of thumb, a 9-point scale is used for the expert evaluation. The scale ranges from 1, which indicates that the two criteria are of equal importance, to 9, which indicates that a criterion is absolutely more important than the other. The major strength of such methodological approach is related to the fact that it enables the expert to evaluate the contribution of each criteria to the goal independently, making simpler the decision-making process (Saaty, 2000).

More in detail, a judgmental matrix, denoted as A, has been built up using the experts' evaluations collected. Each entry a_{ij} of the judgmental matrix is formed comparing the row element A_i with the column element A_j:

$$A = (a_{ij})(i, j = 1, 2,\ldots).$$

The judgmental matrix A built up assume the form of a positive reciprocal pairwise comparison matrix. Then, the weight coefficients of the criteria have been calculated by finding the principal eigenvector w of the matrix A. At the end, the values of all the criteria ware normalized to 1.

Finally, in order to check the overall judgment consistency, we calculated the consistency ratio (CR); such index is usually considered acceptable for values lower than 0.1 (Ramanathan 2001). In our case, the CR was 0.014 so considered largely acceptable. The results of the pairwise comparisons made by the experts are presented in Fig. 5.



Fig. 5 Pairwise comparison

The operational costs represent the most important criterion according the experts followed by the adaptability to the existing collection system and by capital costs. The job creation, on the contrary, represented the one rated as less important among the 7 criteria. We used the so ranked criteria to evaluate the best scenario among the 6 presented in the previous section.

4.2 Scenario ranking

Making use of the ranked criteria, we assessed the performances of each scenarios. The results are presented in Fig. 6.

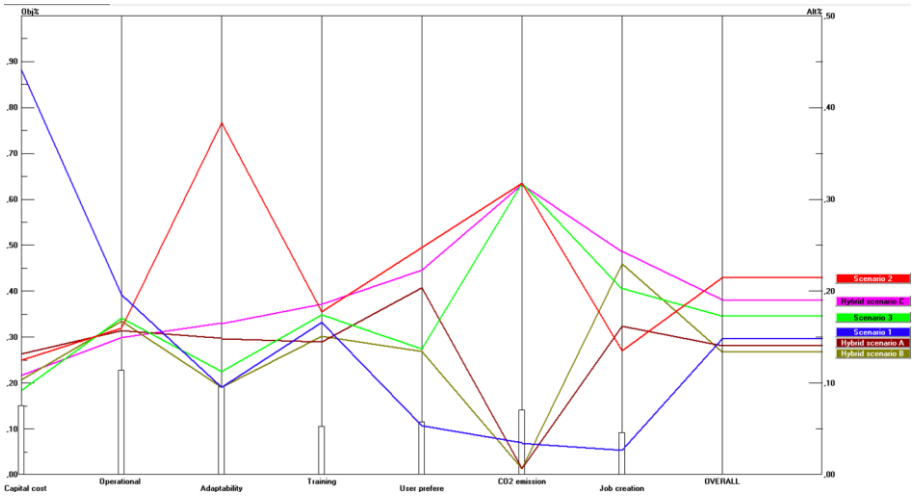

Fig. 6 Scenario analysis

More in detail, Fig. 6 shows how the best scenario performs compared to the other scenarios in terms of single criterium and in terms of overall performance. The figure, on the left y-axis, provides both information on each criteria's priority and on the performance of each scenario in relation of each criterium. Results shows that Scenario 2 resulted to be the best one among the six evaluated followed by the Hybrid scenario C that performed 2.5% worse.

In order to deeper investigate the top two ranking scenarios, we produced also a head to head assessment of Scenario 2 vs Hybrid Scenario C which is presented in Fig. 7. The biggest difference between the two scenario is represented by the degree of adaptability which in Scenario 2 is about 4% higher than the one provided by the Hybrid Scenario C.

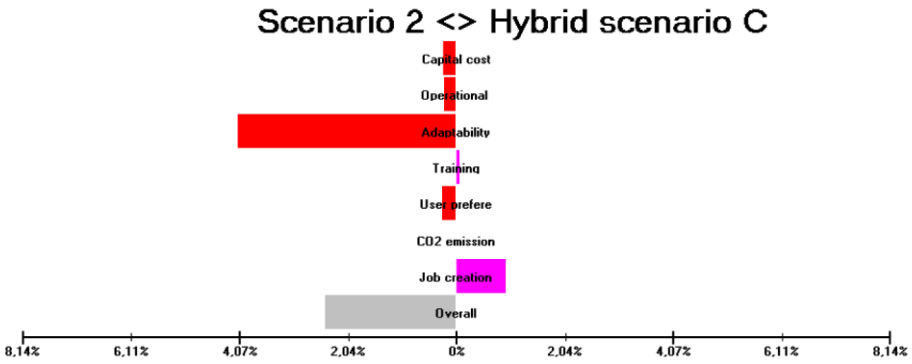

Fig. 7 Scenario 2 vs Hybrid Scenario C

5 Discussion and conclusion

Our results show that Scenario 2, where used diapers are collected by a curbside door-to-door collection system with a weekly based collection frequency, resulted to be the optimal one end the most consistent for disposable diapers collection.

Under a managerial perspective, our work provides useful considerations for the design and implementation of specific separate collections within the waste management system. Indeed, the results of our evaluation support the fact that a dynamic collection organized through a booking service (i.e. by call or by an online booking service) remains the best option for collecting large and bulky waste. In such case, indeed, the waste collection company can perform a superior organization of the logistic activities by optimizing the routes and the loads, organizing them also over a longer time frame. Disposable diapers are in fact unsuitable to be stored for long period of time by citizens.

Some considerations can be done also for the waste collection centers (WCC). Also, in this case, our results confirm that such kind of collection is mostly suitable for large and bulky waste and for those typologies of small size waste that can be also stored for long period of time (such as for instance waste electrical and electronic) with no hygienic problems. Such aspect is further supported by the fact that that also the hybrid scenarios concerning the usage of WCC together with an additional way to collect diapers (i.e. Hybrid Scenario A and Hybrid Scenario B) are as well bottom ranked in our investigation. Within this respect, a factor that could influence such ranking, might be represented by the number of WCC and the geographical localizations of those. Waste management companies

with fewer economic resources aiming at implementing a diapers waste collection might also leverage on WCC (i.e. the cheapest option) if those are fairly accessible by a large share of population. In such case, other managerial issues (e.g. openings time, trained personnel required, etc.) must be then wisely evaluated.

Under a methodological perspective, our research represents also an example on how different methodological approaches and data gathering procedures (i.e. structured interviews, questionnaires, industrial data, expert decisions) can be used together for an in-depth scenario building and complex scenario evaluation for the activities conducted in waste management companies. Further research could test the replicability of the approach also in other industrial settings (e.g. evaluation of alternative production cycles, logistics planning, sustainable supply chain partner selection, etc.).

Despite the relevance of our results there are some limitations we must acknowledge. For instance, the behavior and potential response from citizens was measured only with one question. Future researches can dig deeper in order to test a scale more reliable for such assessment. Moreover, we must also acknowledge that the "adaptability", which ranked second out of seven criteria, was assessed in a qualitative way using only experts' evaluation, as a different approach wouldn't be possible; also, in this case, future research can contribute in better shaping such indicator also through some quantitative indexes.

Finally, we must consider that our investigation was conducted in an area where a curbside door-to-door collection was already in place. Different results can be achieved in assessing similar scenarios in a context where the waste management company and the inhabitants are unfamiliar with this waste collection methods. Future research can deeper investigate such aspect grounding the scenarios in a different context where a door to door collection was never tested before.

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Task Shifting in Home Care Nurses: An Italian Multiple-Case Study

Eleonora Gheduzzi*

School of Management
Via Lambruschini 4/B
20156, Milano

Maria Picco

Local Health Authority of Milan area
Corso Italia 52
20122, Milano

Cristina Masella

School of Management
Via Lambruschini 4/B
20156, Milano

* *Corresponding author*

Abstract

A sustainable healthcare system requires moving assistance from the hospitals to patients' homes. This new model of care requires the home care organizations to review the role of home care professionals. This change of work practice is particularly relevant for nurses that are a key figures in the process of value co-creation. To support healthcare providers and policy-makers in guiding this change, this research aims at studying the mechanism of task shifting in home care nurses using an ecosystem perspective. Given the exploratory aim of the study, a multiple-case study methodology was chosen by selecting four home care providers in Italy.

Results revealed that the role of the nurses is evolving through all three typologies of task shifting: enhancement, innovation and delegation of activities from general practitioners to healthcare assistances. The types of activities that were shifted among professionals, patients and their caregivers were interactive and administrative activities mainly, but also care and educational tasks. The root causes that led to the shift of tasks during home care assistance were organized into four categories: organizational, patients' needs, environmental and individual forces. Finally, this research made a first attempt to study the influence of task shifting on the other actors of the service ecosystem. Results revealed

that the activities that nurses performed in addition to their routine activities influenced the micro, meso and macro levels.

Keywords – task sharing, primary care, sustainability, nurse, skill mix. *(max 5 words)*

Paper type – Academic Research Paper

1 Introduction

A sustainable healthcare system requires moving assistance from the hospitals to patients' homes (Glomsås et al., 2022; Hoel et al., 2022). The 'aging in place' has been pinpointed as one of the main drivers for improving the quality of life of elders and the sustainability of the health and welfare systems (Pillemer et al., 2011). However, the home care organizations have faced several challenges in adopting this model of care. Moving professionals from the hospital to the house of the patients required home care organizations to coordinate professionals, promote inter-professional cooperation, and provide adequate infrastructure to all professionals (Carlson et al., 2014; Fatemi et al., 2019). Meanwhile, the home care setting created limited occasions of interactions between colleagues and opportunities of career development, affecting the work satisfaction of home care professionals negatively (Maier et al., 2022).

Within this scenario, the role of home care professionals needs to be reviewed and rethought (Abrokwa et al., 2022; Groenewegen et al., 2021). This change of work practice is particularly relevant for *nurses* that are key figures in the process of value co-creation (Echeverri, 2022). In discussing the role of home care nurses, Melby et al (2018) stressed the importance of strengthening the professional expertise and organizational skills of nurses (Melby et al., 2018). More recently, scholars claimed that updating nurses' competences might not be enough because the role is evolving constantly. As piece of a complex puzzle, the role of home care nurses is the result of the interactions between different parts of the integrated healthcare system. The exchanges between nurses and professionals of their or other organizations (organizational force), patients and their families (patients' needs force), and the economic, technological and social context (environmental force) influenced the boundaries of the nurse's role (Bartram et al., 2022; Chen et al., 2022). There is a need to study the evolution of the nursing role for supporting its profession advancement, the effective implementation of the

'aging in place' model of care, and, thus, the co-creation of value (Chen et al., 2022; Katsuda et al., 2022).

This paper provides a first contribution in this direction by studying: "*How do home care nurses interpret and adapt their role to the environmental, organizational and customers needs changes?*" In doing so, it contributes to the human resource management research by clarifying the evolving mechanism of the nursing role in the home care setting. Meanwhile, it also helps healthcare organizations and policy makers in recognizing (and managing) task shifting phenomena. Ignoring task shifting may reduce nurses and other professionals' motivation and effort in overcoming the boundaries of their roles. As presented afterword, nurses and other professionals change their roles for facilitating the process of value co-creation. Thus, not recognizing (and managing) professionals' effort in this direction may have negative impacts on patients and professionals' well-being, and on the performance of healthcare organizations and national healthcare systems.

2 Theoretical background

2.1 Role of professionals in the process of value co-creation

Echeverri (2022) claimed that front-line professionals, such as nurses, are key actors in the process of service delivery. The interactions and exchange of resources between front-line professionals and customers are the key source of value co-creation (Echeverri, 2022). The inability or unwillingness to address customers' needs and requests can lead to negative consequences on patients and the healthcare organization (Plé, 2017). For this reason, recent studies have started to devolve attention to the process of value co-creation (Osborne et al., 2018). The source of value is not the organization but the moment in which which front-line professionals and customer interact (Grönroos, 2011).

In this direction, Katsuda et al (2022) investigated how the evolution of nursing role can influence the process of value co-creation. Findings revealed that the innovation of nurses role influenced the process of value co-creation at micro, meso and macro levels (Katsuda et al., 2022). In other words, the revision of nurse's role had some effects on the nurse and their patients (micro level), on the healthcare organization in which the nurse is employed (meso level), and on other public or private organizations that are involved in the process of service delivery

(macro level) (Palumbo & Manna, 2018). This finding highlighted the importance to study, understand and monitor the evolution of roles among health professionals using an ecosystem perspective (Chen et al., 2022). Indeed, the evolution of role is the results of a dynamic and complex mechanism that can affect all the stakeholders of the service ecosystem (Katsuda et al., 2022).

2.2 Task shifting

Task shifting was defined by the World Health Organization (WHO) in 2008 as 'the rational redistribution of tasks among health workforce teams'(WHO, 2008). This definition has been usually seen as the shift of easy task from high to less professionalized professionals (Fulton et al., 2011). Schalkwyk et al. (2020) considered this interpretation of task shifting definition too simplistic. Thus, they proposed a new comprehensive framework that deconstruct the traditional linear professional hierarchy. Nurses, doctors, pharmacists and the other home health professionals are at the same hierarchical level and can shift tasks from each other. Within this exchange of tasks, patients and technologies have also a role. Empowered patients can simplify the role of professionals by performing caring and administrative tasks alone. Similarly, technologies (such as information systems) can decreases the number of administrative activities for professionals (van Schalkwyk et al., 2020). The modalities though which tasks are shifted among professionals, patients and technologies were conceptualized into three main typologies:

1. *Enhancement*: increasing the scope of the role by enriching the tasks or skills of a particular group of workers;
2. *Substitution/delegation*: shifting one activity from one professional figure to another, breaking traditional professional boundaries;
3. *Innovation*: creating new role by introducing a new type of worker (or technology) (European Commission, 2019; van Schalkwyk et al., 2020).

The healthcare literature conceptualized and organized the types of tasks that can be shifted among professionals, patients and technologies. Andrade et al (2017) organized the nursing practices in home care setting in four main groups of activities:

1. *Interactive activities* include the communication tasks and the capacity of managing relations between the different professionals, caregivers and patients (Hjelle et al., 2018);

2. *Educational activities* refer to the training and educational support for increasing knowledge and capabilities to perform new activities (Toye et al., 2016);
3. *Care activities* include all the health activities, including self-care practices and the implementation of advanced/specific tasks (e.g. diagnosis of health status, medication treatment) (Craftman et al., 2018; Øfsti et al., 2020);
4. *Administrative activities* referred to all the organizational and managerial actions performed by professionals or patients (e.g. supervision and control or resources, joining decision-making processes) (Andrade et al., 2017; De Vliegher et al., 2016; Saari et al., 2018).

Finally, the extant literature has devoted much effort in studying the root causes of task shifting. Why should tasks be shifted and role evolve? It would be much simpler leaving roles, activities and responsibilities as they were conceptualized years ago. However, the evolution of roles is often unpredictable and unstoppable. Being the result of the evolving dynamic relationships between professionals and the health ecosystem, the roles are evolving constantly. We organized the extant literature and classified the causes of the evolution of nurse's role into three macro categories:

1. *Environment forces* include the contextual causes of roles' change. For instance, the launch of new technologies (such as telemedicine), the introduction of new health policies, or the occurrence of external events (such as Covid-19 pandemic) can influence the role of nurse dramatically (Bartram et al., 2020, 2022).
2. *Organizational forces* refer to the necessity to review the modalities of collaboration among professionals for adopting new modalities of care (e.g. interdisciplinary teams), for increasing effectiveness and efficiency of organizations, and for facing the shortage of workforce and resources (European Commission, 2019).
3. *Customers forces* include the causes of role's evolution that are linked to the professionals' willingness to respond to patients and caregivers' needs. Since the needs of patients are changing constantly, the professionals are asked to modify their tasks to address their needs in a better way (Osborne, 2021).

Whilst these findings clarify the boundaries of the concept of task shifting, there is a dearth of evidence about the mechanism of the evolution of the nursing role in EU(Chen et al., 2022). This paper aims at filling this gap by investigating four empirical case studies in the north of Italy.

3 Method

3.1 Context

Given the exploratory aim of the study, we chose to adopt a multiple-case study methodology (Yin, 1994) by selecting four home care providers in Italy. We preferred to select a set of cases that belong to the same country because they share the same rules and regulations, making results comparable. Italy was selected because the topics of home care and task shifting are much debated (Anelli, 2019; Presidenza del Consiglio dei Ministri, 2021). We selected a specific period (i.e. summer 2021) that allowed us to study the influence of Covid-19 pandemic. In addition to the legal and contextual factors, other drivers can influence the evolution of roles such as digital technologies and the organizational structure. Therefore, we selected a set of home care organizations that differ for (i) the level of digitalization and (ii) the type of contract with the home care organizations. In doing so, we took into account the organizational force (i.e. type of servive and the type of nurses' contract) and the environmental force (i.e. the country's regulations, the Covid-19 pandemic and the level of digitalization). We did not take into account the customers' needs force because we supposed that patients in the north of Italy shared similar needs.

A brief description of each home care provider is summarized in Table.1.

Table 1 Italian home care providers

Home care organizations	Description	Environment-Level of digitalization	Organization-Nurses' contract
Six Case della Salute of the AUSL Piacenza	Six community centres that represent the point of first access to primary care and outpatient problems in Piacenza. Among the several activities, they manage the network of home care assistance.	Medium-high level	Nurses are employed by the organization
Fond. M. Grassi	An outpatient clinic that offers to free-lance nurses the opportunity to create a reference point on the territory for nursing services, health education and prevention activities, and multidisciplinary home care services.	Low level	Nurses are free-lances
PAXME	A group of social cooperatives that provides home care assistance and services.	Medium-high level	Nurses are employed by the organization
OSA	A health cooperative that provides home care assistance and functional recovery activities, and manage nursing homes.	Low level	The majority of nurses are free-lances

3.2 Data collection and data analysis

For each case, at least one semi-structured interviews was performed. Each interview lasted approximately 40 minutes and was conducted online via Zoom or Microsoft Teams in June and July 2021. In accordance with the aim of the research, the interview main aim was to study how home care nurses were interpreting and adapting their role in response to changes at organizational, environmental and customers' needs levels. The interview's structure was organized in three main sections:

- Section 1 aims at studying the perception of their role and how is evolving in terms of activities not formally recognized that they perform;
- Section 2 aims at studying the contextual drivers that generate such activities;
- Section 3 aims at studying the opinion about the evolution of their roles in the future.

Table 2 Home care professionals involved in the interviews

Home care organizations	Number of interviews
Case della Salute	6 nurses
Fond. M. Grassi	1 nurse
PAXME	2 nurses
OSA	1 nurse

The interviews were recorded, transcribed and anonymized. All interviewees gave their consensus to use the interview for research purpose and to report results in aggregate form. The interviews transcripts were analysed through NVivo v.12 software. We decided to adopt a content analysis using an abductive approach (Spens & Kovács, 2006). Whilst the case study is exploratory and innovative in its nature, we preferred to investigate findings taking advantage of the existing frameworks and knowledge on task shifting in healthcare (Kovács & Spens, 2007). In particular, one author used:

- The dimensions of the theoretical framework of the European Commission to investigate the typologies of task shifting: enhancement, substitution/delegation and innovation (European Commission, 2019);
- The theoretical taxonomy of Andrade et al. (2017) to investigate the types of activities/tasks that are shifted or introduced: interactive actions, educational actions, care actions, administrative actions (Andrade et al., 2017).
- The root causes suggested by the healthcare literature presented in the introduction section: environmental, organizational and customers' needs changes. the empirical setting.

The issues related to the framework's capacity to explain the empirical observations were discussed among authors. The emerging 'deviating observations' were explained and discussed through 'the creative iterative process of theory matching' that aims at refining and mixing the prior theoretical framework with other theories (Kovács & Spens, 2005). In doing so, we added new dimension for the root causes (i.e. individual force). This new dimension confirms the existing literature findings regarding roles' evolution that recognize personality and attitude of professionals as a driver for task shifting (Manjunath et al., 2022).

The final coding matrix is organized in the following three dimensions and related sub-dimensions:

1. Typologies of task shifting
    - Enhancement;
    - Substitution/delegation;
    - Innovation
2. Types of activities
    - Interactive actions;
    - Educational actions
    - Care actions;
    - Administrative actions.
3. Root causes
    - Environmental force;
    - Organizational force;
    - Individual force.

4 Results

The results were organized according the three macro dimensions of the final coding matrix: typology of task shifting, types of activities and root causes. Thus, the first two paragraphs clarify the phenomena of task shifting, while the last paragraph describes how home care nurses are adopting their roles according to the organizational, environmental and customers' needs changes.

4.1 Typologies of task shifting

To investigate the typology of task shifting, we referred to the theoretical taxonomy proposed by the European Commission: enhancement, substitution/delegation, and innovation (European Commission, 2019).

The recurrent category of task shifting was enhancement (82% coverage of the dimension "typologies of task shifting"). This result shows that the role of nurses was not renewing completely. Nurses made incremental changes in their role by performing tasks that expand and enrich the traditional nurses' activities.

> *"It is happening during patients visits. For instance, when you visit a patients, who received a medication two days ago. The lesion was dispensed with blood perfectly two days ago. But the day of the second visit, the lesion is black necrotic. Thus, you are aware that something is*

wrong and you have the professional duty to ask yourself why [even if it is your nurse's responsibility]. You have to solve the situation despite nobody tells you any information or support." (Nurse; Enhancement)

The second typology through which the role of nurses evolved was innovation. The Case della Salute introduced a new organizational model that led nurses to gain a managerial role. In each Case della Salute, one nurse was in charge to open and manage a clinic, in which one or two nurses were employed, supporting diabetic patients in their treatment. The nurses interviewed considered themselves no longer an executer that follow physicians' decision but a coordinator that manage a small team of professionals. This new model of care allowed nurses to assume a new role and to gain additional responsibilities.

"Nursing outpatient clinics were opened for full and direct management of nurses" (Nurse, Cds; innovation)

"We are no longer health care workers there by accident: but I know what's going on in the next room, I know what's going on outside my square foot of outpatient clinic" (Nurse, Cds; innovation) 65

There were only few examples of the third typology of task shifting: substitution/delegation. In particular, the general practitioners asked the nurses to perform activities of their place, such as evaluating the possibility to activate the home care assistance. The delegation of activities occurred only when the general practitioner had a trustful relationship with the nurse. The interviewees stated that delegating tasks in home care setting is difficult because nurses are alone at the patient's home. The limited interactions with other professionals (e.g. general practitioners, health assistance, physiotherapists) limits the chance to delegate the routine activities to other professionals.

"The doctor calls me and says: come with me to this patient and you tell me whether to activate ADI or not" (Nurse, OSA)

"I was contacted by a GP that told me: "I got a call from a patient who wants to activate home care" I said: "Doctor, have you seen her yet?" "No, you go then tell me what to do" (Nurse; OSA)

"In ADI delegating is difficult, because when you're at home alone... You're alone. There is no colleague to ask to do something for you" (Nurse, OSA)

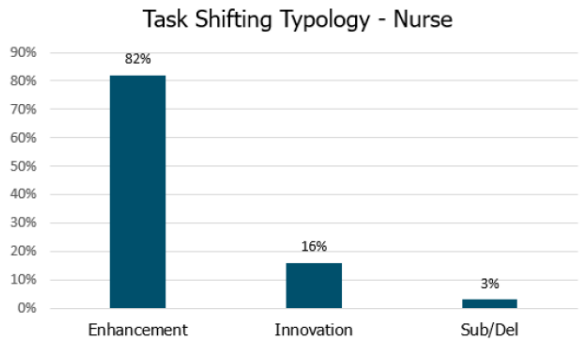

Figure 3 Task Shifting typologies

4.2 Types of activities

The activities that nurses performed outside the boundaries of their role mirrored the taxonomy proposed by Andrade et al. in 2017: care, administrative, interactive, and educational activities.

The recurrent extra-activities that nurses introduced in their tasks were interactive activities at macro, meso and micro levels (39% of codes). Nurses had often to communicate with different actors such as specialized clinicians, general practitioners, social workers, and other healthcare professionals (meso and macro levels). Moreover, patients and their families often asked nurses advices and emotional support (micro level). In many cases, nurses became a reference point for families without being recognized at the regulatory level.

> *"There is a part of what we do that is not formalized, which is the part related to the relational aspect, to communication, to the management of aggressiveness, to interpersonal relationships. For example, it is difficult to formalize "I went shopping because the patient needed milk and the family member was not there." (Nurse, FMG; Interactive activities).*

The second type of additional activities performed by the nurses are the administrative ones. Nurses are in charge of managing and organizing patients' care in accordance with other professionals. In doing so, they often acted as a bridge role between the different organizations and entities of the local area, with a positive impact at macro and meso level.

> *"The care provided by different healthcare figures must be coordinated because otherwise it's a useless job. However, the decision of contacting and coordinating out care with the one of other professionals is our choice.*

Not every nurse decides to manage and coordinate his/her care with others; it's a very individual choice. At the same time, if we are not try to coordinate care, no one will do" (Nurse, OSA; Administrative activity)

Nurses performed some care activities as extra-activities, enhancing the role of the nurse. They often made health care decisions and did caring activities that were not prescribed by the physicians or that were not within the boundaries of their role.

"I saw a patient that needed an intravenous feeding; he is an elderly, cardiopathic and dehydrated patient, so I decided to measure his pulse: 150 beats. I immediately said, "I'm not going to put an intravenous feeding on a patient like that. Let's call the ambulance or the GP!" But I could have just put the intravenous feeding and left" (Nurse, PAXME; Care activity)

Although the code of ethics requires nurses to train patients and their caregiver, sometimes nurses dedicated much more time and effort in these activities than what is required, with positive impacts on caregivers and patients (micro level). For instance, they provided advices even when this information did not refer to nurses' activities.

"If you go there and you only want to perform the caring task, it takes 10 minutes. Instead, if you want also to train patients and their families about self-caring activities, i.e., nutrition's' principles for diabetic patients, how to wash, the visit will last a bit longer." (Nurse, PAXME; Educational activity)

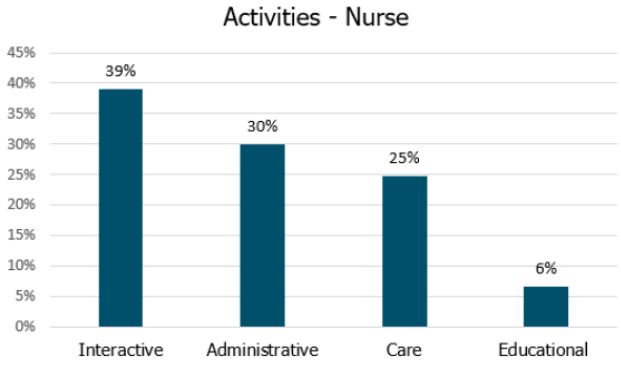

Figure 2 Task Shifting activities

4.3 Root causes

The root causes that led nurses to shift their tasks can be organized in four main section: patient needs' force, organizational force, environmental force and individual force, as reported below.

4.3.1 Patient needs' force

The health, social and economic needs of patients drove changes in the routine activities of nurses. These needs were unexpected needs, which arose during patients' visit all of a sudden, or persistent needs, which recurred for a medium-long period because they had never been satisfied. Patients' needs were a root cause of task shifting because nurses, who have the duty to help patients, were pushed to perform activities even beyond their role for addressing patients' needs.

> *"All begins to help patients, which is our goal at the end of the day" (Nurse; PAXME)*
>
> *"But since it is the only way for activating the service, you do it. As a nurse, you are aware of the patient needs, so prefer to do it" (Nurse; OSA)*

Interestingly, nurses changed their role to accomplish not only patients but also caregivers' needs. In many cases, nurses introduced additional activities to support and train caregivers in performing caring activities for their dear ones. During visits, caregivers were usually present and took advantage of the nurse's presence for making requests and questions about caring activities. For this reason, nurses felt the pressure to act professionally, be competent and able to manage the situation.

> "*The caregiver is smarter and more competent. S/he is watching you and observing you constantly. You can't get rid of her/him. You have to be competent, professional, sensitive, and empathic.*" *(Nurse, FMG)*

4.3.2 Organizational force

The lack of resources of home care organizations was a root causes for task shifting in nurses. More precisely, the lack of personnel was forced nurses to perform activities that were not within their role's boundaries. The lack of other professionals' availability led nurses to substitute others or integrate their activities.

"There has always been too much work to do. It increased with the pandemic, but there would have been high workload anyway. More time pass[, less we are], more work becomes" (Nurse, OSA)

"Because if the nurse doesn't have time to do certain things, he or she will delegate them to the health working assistance" (Nurse, OSA)

Moreover, the necessity to pursue a certain level of services' effectiveness and efficiency forces nurses to enrich and revise their role. For instance, home care organizations requested nurses to collaborate and integrate their activities with other professionals for increasing the effectiveness of the treatment.

"If the nurses, health working assistance or any other type of operators working within the Case della Salute would see this opportunity to be able to work together in integration, this can evolve their figure" (Nurse, CdS)

Finally, the working approach of the home care organizations influenced the role of nurses steadily. In the cooperatives, nurses were usually work alone. Thus, in certain situations, the nurses, who cannot ask for the immediate support of a colleague, have to decide the activities to perform, even if they are not of his/her direct competence.

"When you're home alone, you're alone. There's no colleague so you say "look I don't have time to do this, you do it" because you're there. Sometimes we do things that are not part of the pure home care activity that we're responsible for" (Nurse, OSA)

4.3.3 Environmental force

The cultural environment influenced the behaviour and attitude of nurses. For instance, nurses have started to be recognized as a crucial figure in the home care setting in the last decade. Nurses were no more a mere executor of physicians' decisions, but the referring figure for patients and their families. This cultural shift influenced the roles of nurses steadily.

"The change is certainly also driven by changing the vision where the nurse is only the one who detects the pressure or gives the injection; it means getting out of a purely performance dimension and understand that health is a much broader good" (Nurse, CdS)

Moreover, some innovative policies led healthcare organizations to revise the role of nurses. In the Case della Salute, nurses were in charge to carry out additional activities such as promoting health and organizing prevention campaigns.

"We started to redesign the chronic care according to the principles of preventive care. This was the main change that was introduced with the new model of care Case della salute" (Nurse, CdS)

4.3.4 Individual force

In some cases, nurses performed additional activities because they decided to do so. To meet the needs of the patients in a better way, they decided to interact more with patients/caregivers, or coordinate with other professionals. Nurses were highlighted that delivering high quality care sometimes required them to provide activities that cross the threshold of his or her own duties. In many cases, these activities were administrative and interactive activities that were put in place for improving the services' efficiency and efficacy.

"Going above and beyond depends on what you want from your role." *(Nurse, FMG)*

"Currently, each nurse behaves according to their personal attitude and preferences, there are not tools or other guidelines for guiding us in monitoring [for instance] the training activities delivered to caregivers."(Nurse, CdS)

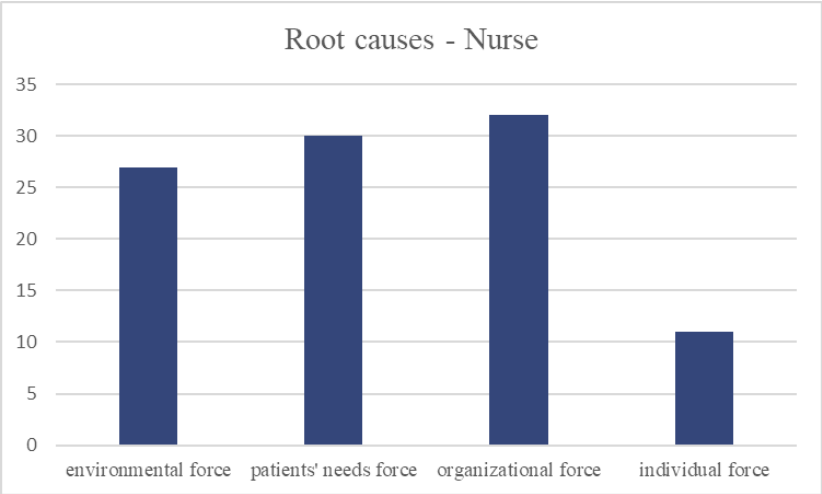

Figure 3 Task Shifting root causes

5 Discussion and conclusions

This study aims at investigating the evolution of the role of home care nurses. In doing so, it analysed the typology of task shifting, the types of activities shifted and the root causes. Results revealed that the role of the nurses is evolving through all three typologies of task shifting: enhancement, innovation and delegation of activities (from general practitioners or to healthcare assistances). The prevalence of innovation on delegation typology may be caused by setting of investigation. Indeed, six interviewees were nurses employed in the Case della Salute whose model of care had reviewed the role of nurses steadily. The types of activities that were shifted among professionals, patients and their caregivers were interactive and administrative activities mainly, but also care and educational tasks. Finally, the root causes that led to the shift of tasks during home care assistance enriched existing literature findings. Results confirmed the three main root causes suggested by the literature (i.e. organizational, patients' needs, and environmental forces) but they also revealed an additional one: individual force. The revision of nurse's role changed according to the personal attitude, motivation and behaviour of each nurse. Thus, the nurses' choice of modifying their role is the results of both external and internal forces. For this reason, the home care organizations in reviewing nurses' role have to dedicate time and effort in personalizing the career pathways and development.

Furthermore, this study analysed the phenomena of tasks shifting in the home care setting with specific attention to its influence at micro, meso, macro levels. Recognizing that nurses in modifying their role can influence the process of value co-creation, the results made a first attempt to study the influence of task shifting on the other actors of the service ecosystem. Results revealed that the interactive activities that nurses performed in addition to their routine activities influenced benefits the communication with specialized clinicians of their organization, general practitioners, social workers of external entities, with positive impacts at meso and macro levels. These interactive activities impacted positively also the micro level increasing the emotional support to patients and their families. Similarly, the administrative and training activities had some benefits on different levels of the service ecosystem.

In conclusion, the study is the first attempt to clarify the mechanism through which nurses make their role evolve over time. Drawing on the previous conceptual frameworks (e.g. (Chen et al., 2022; Katsuda et al., 2022; van Schalkwyk

et al., 2020), Figure 4 provides an overview of the task shifting mechanism of home care nurses. In doing so, it displays the existing literature findings in blue and highlights in yellow the main contribution of this paper.

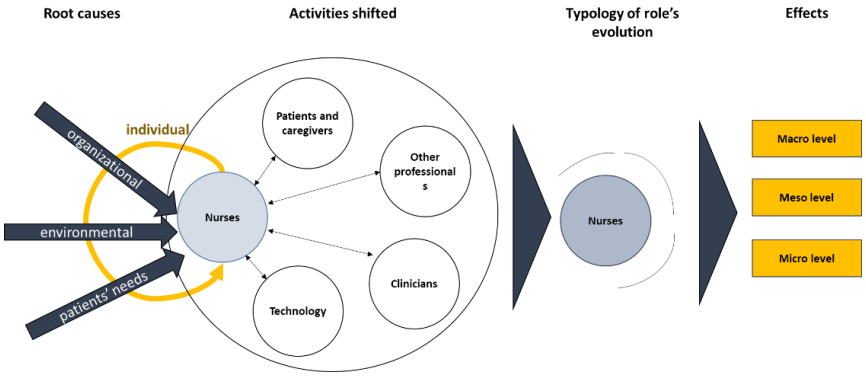

Figure 4 Task Shifting mechanism, starting from the conceptual frameworks of Chen et al., 2022; Katsuda et al., 2022; van Schalkwyk et al., 2020.

This research has some major limitations. First, the number of interviews are limited that made impossible to drive considerations from the specific characteristics of the four settings. Second, the exploratory nature of this study makes findings hard to generalize. Further studies are needed to test enrich and validate the task shifting mechanism. Finally, the effects of the task shifting mechanism were only inferred from the analysis once the finished interviews. Future studies will have to enrich the interviews' transcript to assess the effect of task shifting on all the actors of the service ecosystem, with particular attention on the interdependencies between micro, meso and macro levels.

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The Potential of Smart Tourism Destinations

Giovanna Andrulli

Department of European and Mediterranean Cultures:
Architecture, Environment and Cultural Heritage
University of Basilicata
Matera, Italy

Abstract

New technologies are being integrated into the urban space of cities and we are progressively talking about smart cities and smart tourism. Tourism is one of the production sectors with the greatest economic impact internationally, as it directly influences cities, the provision of their services and the way people live together. It is therefore from this that the smart and sustainable tourism destination approach is conceived, influencing city dwellers and the environmental footprint of the tourism experience. In the belief that combining digital intelligence with spatial systems can improve the standard of living and raise the quality of services, the aim of the research is to explore places where the environment and the technological system are closely related, creating a greater dialogue between the various social components of these spaces, with interesting effects also in terms of relational cohesion. Spatiality is not only a physical concept, but it is linked to notions of digital geography, which we define as Phygital, in which the physical and virtual environment are combined to enhance the tourist experience. Considering the strategic axes of innovation, digitisation, accessibility and sustainability, the resulting positive impacts are distributed among economic, social and technological actors, enhancing tourist sites with improved physical and digital accessibility, and generating a competitive and inclusive type of tourism. There are many virtuous examples of STD in the world to take inspiration from, and the article takes the case study of the city of Càceres as a reference to make some reflections on smart tourism.

Keywords – Smart tourism, smart city, phygital, empowerment of citizen and tourists.

Paper type – Academic Research Paper

1 Introduction

Contemporary society is experiencing a scientific revolution marked by the growing importance of Big Data and the development of related technologies, which permeate every aspect of our life and culture. The 21st century is characterised by interactions between the physical and virtual worlds, thanks to the progressive creation of a global connective space with a high intensity of information flows. Urban contexts are increasingly evolving towards digital ecosystems to improve the capacity of services, respect the environment, and boost the local economy by supporting businesses and enhancing the cultural and tourism sectors, in an eco-sustainable perspective as set out in Agenda 2030. The city of the future, in the face of a series of adaptations, transformations and integrations, coordinates its own urban and functional restructuring to rationalise services, functionalise neighbourhoods, reuse spaces, decongest traffic, save energy, involve citizens and boost tourism. Internet of Things, Internet of Everything and Internet of People are concepts that envisage how in the physical city objects, devices and people will be increasingly interconnected through the infrastructure, and relying heavily on new technologies, resilience, ecological efficiency and environmental control are envisaged, even in places far from the production hubs, through network access for all (Mezzetti, 2005).

Realising an intelligent city requires transformative processes according to the complexity of the human-environment interrelation and in overcoming what we call urban diseconomies. Design is not only built with data, but above all through everyday life spaces, representations, phenomena, symbols and shared values that mark spaces. Technology is not an end in itself, but a means to create what is called a 'humane city', where new ways of decision-making are proposed in a networked sense to activate the community's capacity for action and the involvement of human capital, resulting in outcomes that spread socially inclusive energies and initiatives (Governa, 2014). On the end of the smart community, which in the idea of the smart community aggregates small centres in jointly addressing issues of interest, the empowerment of individual citizens and tourists is fostered, who will be equipped with the skills to interact in the changing economic system. Urban planning must therefore take into account the relationship between the built and the non-man-made contexts, in order to preserve the integrity of ecosystems and increase those spaces that generate well-being. In this sense, the involvement of communities is fundamental in co-

designing because they live the territories, perceive their problems, have specific priorities, and it is right to take them into account in the general diagnosis for an urban regeneration capable of mitigating the effects of the social, environmental and climate crisis (Magnaghi, 2000). In a logic of sustainable development, it is the intelligent integration on an urban scale of a whole series of technologies that gives centrality to the human dimension, assuming citizen-driven as well as human-centred processes. The smart city cannot just be a technological challenge, it must above all be a social challenge. The key infrastructure of a smart city is its citizens and tourists. The contribution offered by technology for urban and territorial planning stems from that all-too-human talent that is reflected in algorithms to support choices that, however automated, will always be the result of human intelligence (Ratti and Claudel, 2017). Digital tools for managing complex systems are at any level a great achievement of the 21st century, it being understood that the most effective tool behind every digital device must remain the human capacity for discernment.

2 Smart cities and smart tourism

Smart tourism, defined by the World tourism organisation as a type of tourism that is "clean, green, ethical and quality at all levels of the service chain", looks to technological innovation as a functional boost to the process of mutation of cities and territories with a tourist vocation. Digitisation and the connection of objects and territories to the Internet therefore enter fully into the DMO (Destination management organisation) with a set of new opportunities, guaranteeing the visitor a complete, attentive and intelligent experience and a more sustainable use of resources. Smart tourist destinations are places characterised by high accessibility and a wide availability of data, in which the diffusion of innovation processes follows an "open" and inclusive evolution, in favour of the community, facilitated by the possibility of creating virtual networks and participatory platforms (living labs) capable of interconnecting all the actors involved in the tourism sector. We can classify a city as smart when sustainable economic growth and a high quality of life have been achieved through investments in human capital, an adequate level of government participation and infrastructures that support the proper dissemination of information throughout the city (Magnaghi, 2005). While the focus of smart cities is on its residents, smart tourist destinations emphasise the enhancement of the tourist experience, thus simultaneously

improving the quality of life of its residents. This dual focus requires an inclusive ecosystem design, which can only be achieved through dynamic leadership and integration of all stakeholders in the development of the smart tourism destination. Therefore, it is important to understand how technology does not simply enhance pre-existing experiences, but takes them to a whole new level, reaching the Smart Experience component to extend the experience to new levels and enhance it through personalisation, context awareness and real-time monitoring. The capillary distribution of the tourist heritage throughout the country constitutes a great potential for development also locally, but it requires a greater effort to identify interventions and mobility services aimed at guaranteeing the accessibility of tourist sites in an adequate manner and within a reasonable timeframe (Gretzel, Zhong and Koo, 2016). Digital accessibility represents a qualifying element for the tourist offer, because through the use of innovative technologies, it enables the enjoyment of a tourist destination before physically reaching it. Digitisation makes the tourist more informed about the services offered and informs operators in the sector about tourist flows, improving the design of services and the travel experience, through a dynamic interaction between the traveller and the tourist ecosystem. The possibility of exchanging data between tourists, and between tourists and operators, allows the development of new services - integrated along the value co-creation ecosystem - at all stages of the journey: from the ability to support the tourist in the choice of destination, to the possibility of offering route planning tools, improving the enjoyment of the destination and transforming the journey into a shared experience. This has been well tested in several countries that have joined the network of European Capitals for Smart Tourism, affirming their relevance in different sectors. From the case of Màlaga and Copenhagen that have strongly invested in digitalisation, to the affirmation of sustainability for Gothenburg that monitors the events taking place in the city benefiting from the Event Impact Calculator, a tool that forecasts potential environmental impacts and helps organisers to evaluate events from an economic, social and environmental point of view, to the importance of digital and physical accessibility for every type of visitor for Lyon with the ONLYLYON Experience that allows to receive information in real time for attractions and transport avoiding congestion in tourist flows (Boes, Buhalis and Inversini, 2016). It is no coincidence that Valencia has been designated as the European Capital of Smart Tourism for 2022, the first European city to receive a double ITU and ISO certification for sustainable city development,

and widely engaged with PREDIF (State Platform for Representation of People with Physical Disabilities). Implementing change requires a structural reorganisation of holiday destinations from a smart perspective with a structural-organisational model that is able to exploit the opportunities arising from the digitalisation of the tourism sector and design evaluation tools suitable for measuring their performance.

3 Strategic research axes

The orientation of this work has been outlined by the strategic axes of innovation, digitisation, accessibility and sustainability, which we decline as follows:

- innovation, understood as the introduction or improvement of new services, processes, marketing methods or organisation in the internal practices of the destination management organisation and in its external relationship with residents and tourists with the aim of improving the benefit they provide and their competitiveness. Innovation, to the extent that it is systematically implemented within an established management system, continually brings new ideas to the destination, proactively generates value through a better understanding of the needs and possibilities of the STD, helps to identify and reduce risks, harnesses creativity and collective intelligence, obtains value from the collaboration of all stakeholders, and promotes the involvement of all by fostering collaboration;
- digitisation, the impact of new technologies on tourism habits has to do with the implementation and extension of their use, in relation to socio-demographic and socio-cultural variables, and with the ability of the Smart Tourist Destination to meet the different needs of the tourist. The complexity of the technological scenario is marked by the diversity and rapid evolution of technologies. New technologies play a major role in the tourism sector, both from the point of view of destination management and from the point of view of the consumer and user of tourist services and products;
- accessibility, involves the development of tourism that allows access to all people, without exclusion, guaranteeing the right to equal opportunities to enjoy the environment, goods, services, products and

technologies in the safest, most comfortable, autonomous and natural way possible. The objective of any STD should first and foremost be to ensure an accessible tourism environment throughout the tourism chain and at all stages of the journey, in absolute freedom and autonomy;

- sustainability, associated with the protection of economic tourism activity in the present and future, with respect for the environment in the short, medium and long term, with the preservation and enhancement of the socio-cultural dimension and with guaranteeing the quality of life of present and future generations of STD. The dimensions of sustainability contemplated in the smart city paradigm are: the economic one related to competitiveness, the social one to quality of life and the environmental one to efficient management of natural resources. However, technology alone does not make a destination smart, a change in tourism management is needed: it must be accompanied by a process of change at all levels, starting with the tourism strategy that should lead to a new model of an innovative, accessible and sustainable destination. Management is therefore the central element in the transformation of the Smart Tourist Destination to be implemented in the face of changes in a complex tourism scene (Díaz, Esteban, Koutra, Almeida and Carranza, 2023). The management of the STD, in addition to considering the axes described, must observe the following principles:
- effectiveness: in accordance with the set objectives, policy and appropriate measures;
- efficiency: in the optimisation of resources;
- openness: transparency towards the tourism sector and local society with an active communication and clear, accessible language;
- participation: public-private cooperation and consensus;
- responsibility: in the decision-making and financial process in order to achieve greater stability and financial self-sufficiency;
- coherence: taking into account the set objectives and policies of the tourist destination.

4 Theoretical model and methodologies employed

Spain has launched a smart-destination initiative for DTIs (Destinos Turisticos Intelligentes), with guidelines (UNE) aimed at tourist destinations, so that they can take advantage of smart city dynamics and projects, also targeting the tourism sector. The presence of infrastructures and services for digital accessibility connotes tourism destinations as "smart destinations", as territorial ecosystems equipped with an advanced technological infrastructure and capable of collecting, processing and analysing information and data from the tourism system in real time, offering tourists the possibility of interacting with their surroundings and improving the quality of the tourism experience. In the urban context, the 'smart destination' is a smart city that provides services aimed more specifically at tourists and visitors: tourists are 'city users' who must be facilitated in their enjoyment of the city, encouraging them to 'experience' it and no longer just visit it. The tourist vocation of many Spanish cities guides their economic and social development strategy, since tourism is one of the most strategic sectors, especially for Smart Cities. It is necessary to have a methodological basis that allows the different tourism actors to approach the implementation of new solutions for the creation of STDs in the right way. We have identified four phases of analysis to follow, starting with the knowledge of tourism regulations. The Spanish UNEs for STDs represent the normative basis to refer to regarding the management system, indicators, tools and semantics applied to tourism. The second phase involves structuring the tourism reality for codification. The tourism manager knows the components of the destination (attractions, places, companies, events, products, etc.) and the traveller profiles. The objective is to sort the destination information and determine the relevant information for each address in order to link the data and create the logistical basis on which to structure the innovative tools to be applied. In the third phase, we can combine serialisation formats in line with the destination's strategy. Increasing the competitiveness of the tourist destination and enhancing the digital visitor experience is essential. To enrich the user experience on the web portal, app and other channels, we need to serialise data according to the Spanish UNE 178503 proposal and to give visibility to the destination websites in the search we can use schema.org (JSON). The fourth and final stage is the analysis and continuous processing of the information received from travellers. The content assigned to each user must be well connected in data chains that must be dynamic and

evolve in line with market trends. This ensures the availability of real-time services and a tourist experience in line with the expectations of tourists.

Urban tourism centres are called upon to combine land management policies with issues of culture, organisation, infrastructure availability, innovation and business, in order to strengthen identity, cohesion, hospitality and security at the local level and, at the global level, their recognition in the network of 'world cities' (Gretzel, Zhong and Koo 2016). Strategic choices and actions must be defined according to the principles of socio-economic and environmental sustainability, enhancing lesser-known destinations and highlighting territorial typicalities in terms of culture, traditions and biodiversity. In fact, one of the objectives is to innovate, specialise and integrate the national tourism offer: it is necessary to focus on a complementary, integrated and expanded offer with respect to the main tourist destinations and products from which to get to know the enormous historical, artistic and landscape heritage spread throughout the territory. Coordination with the Industry 4.0 strategy and its synergies with the service system is necessary to encourage the technological upgrading of the tourism supply system and strengthen its competitiveness. The theme of digitalisation and innovation is a particularly important aspect for the competitiveness of the tourist destination, trying to counteract the gaps in terms of digital public services, human capital, integration of digital technologies, internet use and connectivity. The impact on consumer behaviour of the content generated by travellers themselves on the web requires, as a goal to be pursued, the complete innovation of promotion techniques and channels, but also a great capacity for continuous adaptation of targets and content, fuelled by reputation monitoring and listening to demand (Ghobakhloo 2020). Dynamic must also be the way of selecting the components of the offer to be promoted, integrating the different territories in the national strategy, enhancing the most attractive territorial brands with the lesser known destinations, the many resources and values, with the plurality of tourism products ready for marketing. For this reason, it is essential to define a monitoring and surveillance system for the Plan based on specific quantitative and qualitative result objectives, shared within the framework of participatory and inter-institutional comparison, which are functionally linked to the permanent analysis of the evolution of competitiveness and global trends in the sector. As demonstrated by the already European capitals of Smart Tourism, digitisation makes tourists more informed about the services on offer and informs operators in the sector about tourist flows, improving the design of services and the travel

experience, through a dynamic interaction between the traveller and the tourist ecosystem (Peris-Ortiz, Bennett and Pérez-Bustamante Yábar, 2017). The possibility of exchanging data between tourists, and between tourists and operators, enables the development of new services, integrated along the value co-creation ecosystem, at all stages of the journey: from the ability to support the tourist in the choice of destination, to the possibility of offering tools for route planning, improving the enjoyment of the destination and transforming the journey into a shared experience.

5 The case study

The application part was developed on the city of Cáceres. The city known as 'the city of a thousand coats of arms' is located in the region of Extremadura in west-central Spain. Its historic centre (or Ciudad Monumental) still retains its walls and was declared a UNESCO World Heritage Site in 1986 on the grounds that, 'surrounded by walls, it is rich in stone buildings that form a perfectly preserved urban fabric'. Cáceres has been committed in recent years to preserving, valorising and publicising its heritage, gaining a greater understanding of the behaviour of visitors and citizens in their relationship with the city, and activating strategies to retain tourists, diversify the consumption of the services on offer and build a system and management model that strengthens the local business sector. The World Heritage city, from ancient to contemporary city, has tripled the number of visitors in 25 years and has an influx of over 700,000 tourists per year. The initiatives promoted by the municipality of Cáceres have led to an increase in the average stay, the number of tourist facilities, the number of tourists and in general the growth of the tourism sector (Álvarez-García, del Río-Rama, Vázquez-Huerta and Rueda-Armengot, 2017).

The smart tourism idea to be implemented is aimed at both inclusiveness and competitiveness of the place, and thus revitalisation in terms of marketing, business and brand creation, but also at monitoring and forecasting risks. The data used for the development of our model are:

- spatial and geo-localisation data;
- data on tourist attractions (type of attraction, service offered, accessibility, maximum capacity);
- time data (average visit time, travel time by different means of transport and timetables);

- infrastructure data (available types of transport);
- data on accommodation (hotels, B&B, holiday homes, restaurants, agritourisms, etc.);
- health and safety data (hospitals, police headquarters, municipalities, etc.).

The software used to carry out the analysis with the opendata of the city of Cáceres are the Onesait platform, ELK Stack, DBeaver and QGIS. The Onesait platform was used to design the work, which integrates services that facilitate the accelerated development and efficient operation of any type of digital solution in an enterprise, accompanied by IoT, Big Data, Blockchain and Artificial Intelligence technologies, enabling descriptive and predictive analysis to improve scalability and business performance. The database has been organised to achieve the best analysis results with ELK Stack. Elastic Stack combines the potential and flexibility of the Elasticsearch, Logstash and Kibana modules for simple, real-time indexing, searching and visualisation of structured and unstructured logs and data. Thanks to the combination of these three components of the ELK suite, various analyses were carried out, which were then grouped in the dashboards (Chhajed 2015). DBeaver, a free software released under the Apache licence for database administration and query execution, was used to manage the city's open data. For relational databases, it uses a JDBC driver and provides an editor that supports code completion and syntax highlighting. This software is written in Java and is based on the Eclipse platform. The spatial data in geojson format were analysed and edited with QGIS, a GIS (Geographic Information System) software that supports both vector and raster data divided into layers, which can be analysed and from which the map image is created with custom graphics enriched with icons and labels dependent on the attributes of the map elements. Below is an example screenshot of the database organisation extracted from DBeaver (Fig.1) and an example dashboard of the tourist attraction analysis extracted from Kibana (Fig.2).

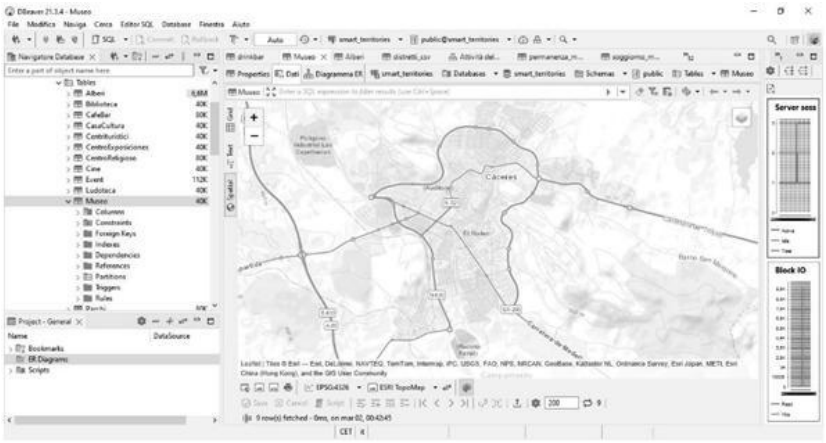

Figure 1: Example of application on Cáceres, extracted from DBeaver software. The different types of geodata contain a lot of information that can be displayed in tabular or map format.

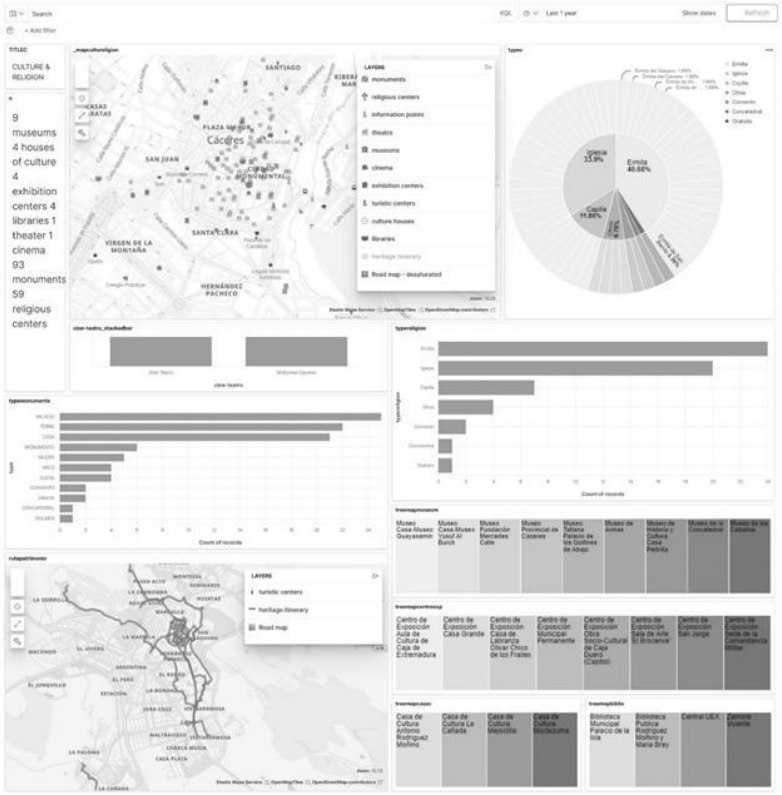

Figure 2: Tourism attraction application extracted from Kibana tool. The culture and religion sector is analysed with different types of maps (maps, treemaps, bars, pye etc.) and shows the distribution of the different types of attractions identified.

6 Conclusions

In the conviction that by combining digital intelligence with territorial systems it is possible to improve the standard of living and raise the quality of services, the objectives to be pursued, according to the strategic axes of innovation, digitalisation, sustainability and accessibility, are:

- Relaunching the competitiveness of the place in an innovative way;
- Creating a tourist offer accessible to all;
- Providing real-time services to residents and tourists using digital;
- Create a monitoring and forecasting plan for proper management;
- Monitoring tourist flows and their sustainability;
- Monitoring the health of places;
- Ensuring care, safety and health in the use of places.

A necessary requirement of the destination is to already have a well-defined tourism aplomb, which can be divided into one or more typologies (cultural, environmental, experiential, etc.) and the need to build a digital infrastructure suitable for the purpose. This makes it possible to increase the competitiveness of the tourist destination, enhancing its natural and cultural attractions, and to create other innovative resources and improve the efficiency of services that promote sustainable development and facilitate visitor interaction with the destination.

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Unveiling the Secrets of Sustainability Disclosure: How Governance and High-Tech Sectors are Paving the Way

Vincenzo Pontrelli*

Department of Management Finance and Technology
LUM University
S.S. 100 Km 18 Casamassima, (BA), 70010, Italy

Arcangelo Marrone

Department of Management Finance and Technology
LUM University
S.S. 100 Km 18 Casamassima, (BA), 70010, Italy

Lara Oliva

Department of Biosciences and Territory
University of Molise, Termoli campus
Via Duca degli Abruzzi, 67, Termoli, (CB), 86039

* *Corresponding author*

Abstract

In recent times, there has been a surge in demands for transparency and accountability worldwide, particularly concerning information on environmental, social, and governance (ESG) aspects due to increasing stakeholder pressures. This demand is particularly important in high-tech sectors, where economic activities can have adverse impacts. However, the quality of ESG disclosure can vary widely across companies. Hence, this study aims to investigate how board characteristics, such as diversity, independence, size, average age, frequency of meetings, tenure, and membership in high-tech sectors, impact the quality of ESG disclosure, using agency theory as a foundation. The study utilizes the ESG disclosure score acquired from Bloomberg to measure the scope of corporate social responsibility (CSR) and comprises a sample of 864 international companies. A multiple linear regression model is used for cross-sectional analysis. The results show that diversity, independence, and size joined to high-tech industry membership have a positive impact on ESG disclosure quality. This study expands the scope of agency theory, by identifying additional determinants, and tests the influence of high-tech sectors on the quality of ESG disclosure. The results have significant implications for policymakers, regulators, and organizations seeking to promote sustainability and social responsibility.

Keywords – ESG disclosure, corporate governance, high-tech industry, sustainability

Paper type – Academic Research Paper

1 Introduction

The contemporary era is characterized by two intertwined phenomena, digital technologies, and sustainability concerns, that have drastically changed our lives.

The rise in public awareness of social, environmental, and ethical issues, combined with the impact of climate change, depletion of natural resources, inadequate working conditions, and corporate scandals, has led to an increase in concerns about sustainability (Money and Schepers, 2007; Reverte, 2009). As a result, socially responsible business practices that align with societal values have gained greater attention (Aerts and Cormier, 2009; Chapple and Moon, 2005), with sustainability investments widely regarded as a means of creating value, presenting opportunities, mitigating risks, lowering costs, and ensuring long-term survival (Aureli et al., 2020). The recent United Nations report on emissions emphasizes the urgent need to reduce carbon footprints and adopt sustainable consumption and production practices (UN, 2022). Media reports suggest that consumers are increasingly demanding sustainable products and business practices (Huang et al., 2023; Berrone et al., 2013). Consequently, environmental, social, and governance (ESG) disclosure has become a crucial aspect of corporate reporting for both scholars and practitioners (Baldini et al., 2018). Firms are now encouraged to adopt sustainable practices that have a lower impact on the environment and society and effectively communicate these efforts through disclosure policies (Manes-Rossi et al., 2021; Eliwa et al., 2021; Raimo et al., 2021; Vitolla et al., 2020a; Wasiuzzaman et al., 2022). Governments are mandating that large businesses evaluate and disclose their impact on society and the environment (Haji et al., 2023) and companies are responding by increasing stakeholder engagement and communication (Ruiz et al., 2021; Herremans et al., 2016). The growing emphasis on sustainability is reinforced by the European Union's latest Corporate Social Responsibility Directive (CSRD) which recognize the social and economic importance of these issue and aims to improve its information dissemination.

Furthermore, in addition to the increasing focus on sustainability, the spread of digital technologies such as big data analytics, artificial intelligence, cloud

computing, robots, and the Internet of Things, has caused significant transformation to the global economy and society (Berman and Bell, 2011; Linz et al., 2017; Porter and Heppelmann, 2015 and Verhoef et al., 2019). However, ICTs have a significant impact on the environment with their power consumption and bandwidth usage accounting for over 0.8 gigatons. The industry consumed approximately 4% of the world's total power supply in 2021, and this is expected to increase to 10% by 2025. To address this issue, the industry is shifting toward using renewable energy technologies and energy-efficient practices (Mohanty and Moreira, 2014). Nevertheless, Hilty (2011) warns that under current economic conditions, the use of ICTs may not lead to dematerialization and could have negative environmental consequences. In contrast, according to Berawi (2020), the ICT industry can have significant indirect impacts on global sustainability (Marrone and Raimo, 2021), including energy consumption, data privacy and security, and governance and transparency. Besides, ICT firms must also consider social factors such as workplace conditions, diversity, employee engagement, and belongingness. Women may face harmful stereotypes and a lack of digital confidence (Grishunin et al., 2022). Other concerns include human rights violations by ICT company providers and leakage of consumers' private data. Sutherland (2016) found that ICT firms that follow the best environmental, social, and governance (ESG) practices demonstrated better financial performance. In this context, governance plays a critical dual role. Firstly, it ensures that companies meet ESG disclosure requirements by providing a framework for decision-making and accountability. This enables firms to promptly and efficiently identify and address ESG risks and opportunities. Companies with strong governance structures are better equipped to manage ESG risks, establish clear ESG targets and performance metrics, and communicate their sustainability performance to stakeholders. Secondly, effective governance is essential for companies operating in the ICT industry, as it has a significant impact on their performance (Rittenhouse et al., 2011). Consequently, by prioritizing ESG factors and implementing effective governance structures, companies can access financing and capital from investors who consider ESG factors in their investment decisions, and also create value for their stakeholders while mitigating risks associated with sustainability challenges.

Despite the increasing significance of ESG disclosure and its correlation with digital technologies in both academia and society, a substantial research gap persists in comprehending the role of governance. Furthermore, we have not

come across any studies that investigate the influence of high-tech industry membership on ESG disclosure quality. In the context of the existing literature, our study aims to investigate the influence of a comprehensive range of governance variables, while also taking into account the impact of digital technologies. Specifically, we analyze the levels of ESG (environmental, social, and governance) disclosure of 864 international firms and we take into account several governance variables, including board diversity (BDD), board independence (BDI), board size (BDS), board average age (BAG), board meeting frequency (BFQ), board tenure (BDT). Additionally, we test membership in a high-tech industry (HTI) to assess its significance.

The remainder of this paper is structured as follows. Section 2 provides a review of the literature, while Section 3 provides the theoretical background and introduces the research hypotheses. The methodology is described in section 4, and the results are presented and discussed in section 5. Finally, conclusions are presented in Section 6.

2 Literature review

Suileek and Alshurafat (2022) suggest that the factors affecting ESG disclosures are diverse, continuously evolving, and numerous and, despite various research efforts to study corporate ESG disclosures, there is still no consensus on the factors that drive such disclosures (Terzani and Turzo, 2021). Given their variable nature across companies, the dimensions of governance play a critical role in this regard.

Several studies have investigated the relationship between board characteristics and environmental disclosure. Halme and Huse (1997) analyzed 140 European companies and found that board size did not correlate with environmental disclosure. This finding was also confirmed by Sartawi et al. (2014) and Fernandes et al. (2019). In contrast, other studies, including those by Akbas (2016), Trireksani and Djajadikerta (2016), Rao et al. (2012), and Raimo et al. (2021), have found that board size, independence, and gender diversity have a positive influence on environmental disclosure. Gender diversity, in particular, has been identified as having a positive effect by Rupley et al. (2012) and Raimo et al. (2021), while Akbas (2016) and Fernandes et al. (2019) found no correlation between gender diversity and environmental disclosure in listed companies. Fernandes et al. (2019) also found a positive correlation between board

independence and environmental disclosure. Sai et al. (2014) and Sartawi et al. (2014) discovered a positive effect of board age on environmental disclosure in samples of 120 annual reports of Malaysian listed companies. Khaireddine et al. (2020) identified a significant positive effect of board size, independence, gender diversity, and activity on environmental disclosure. Additionally, Giannarakis et al. (2020) found a positive correlation between board activity and environmental disclosure in US companies. However, Michelon and Parbonetti (2012) and Ofoegbu et al. (2018) found no correlation between board activity and environmental disclosure in companies. Mahmood et al. (2018) found a significant and positive relationship between board size and sustainability disclosure of Pakistani companies.

Regarding corporate social responsibility (CSR), Barako and Brown (2008) discovered that board independence and gender diversity have a positive impact on the level of CSR disclosure of Kenyan banks. However, Khan (2010) observed no correlation between board gender diversity and CSR disclosure of Bangladeshi banks, unlike independence, which has a positive effect. Kiliç et al. (2015) found that board independence and gender diversity significantly influence the CSR disclosure of Turkish banks, while board size has no effect. Similarly, Said et al. (2009) found no negative impact of board size on CSR disclosure in a sample of 150 Malaysian listed companies.

In terms of ESG disclosure, Faisal (2018) examined a sample of 73 Indonesian listed companies and found that larger board size has a negative impact on ESG disclosure. In contrast, Giannarakis (2014) analyzed a larger sample of 366 Fortune 500 companies in 2011 and found a significant positive correlation between board size and ESG disclosure. Similarly, Khoiriawati and Nuswantara (2021) found a positive correlation between board size, independence, gender diversity, and level of ESG disclosure in Asian companies. Lavin and Montecinos-Pearce (2021) confirmed that both board independence and gender diversity have a positive influence on ESG disclosure. Additionally, Cucari et al. (2018) found a positive effect of board independence on ESG disclosure, while average board age had no significant effect on ESG disclosure in Italian companies. Husted and de Sousa-Filho (2019) pointed out that board size and board independence positively influence ESG disclosure, while board gender diversity has a negative impact. Conversely, Wasiuzzaman and Wan Mohammad (2020) found a positive impact of gender diversity on ESG disclosure in a sample of 78 Malaysian companies.

Regarding gender diversity, Giannarakis et al. (2014) examined 100 companies in the S&P 500 index between 2010 and 2015 and found no significant effect on ESG disclosure levels. Giannarakis et al. (2020) indicated that a lower average age of directors has a negative effect on sustainability disclosure, while higher levels of independence improve environmental disclosure. Moreover, Al-Amosh and Khatib (2022) found that foreign and state ownership are crucial factors in determining the level of disclosure, in addition to the role of independence. In terms of ownership, Chung et al. (2023) analyzed ESG disclosure practices in Hong Kong listed companies and found that concentrated ownership has a negative impact on the amount of ESG information disclosed, particularly during voluntary disclosure.

Ultimately, as noted by McBrayer (2018), governance factors are decisive determinants of the quality and consistency of ESG disclosure. This study seeks to comprehensively examine the relationship between ESG disclosure and governance variables while adopting an international perspective. National sampling has led to inconsistent findings in previous research, and high-tech companies have not been extensively studied in this area. Therefore, this study also aims to investigate the impact of the high-tech sector on ESG disclosure quality, which remains unexplored. By addressing these gaps, this study contributes to our understanding of the role of ESG disclosure in high-tech company governance from a broader, cross-national perspective.

3 Theoretical background and hypothesis development

Building upon the existing literature that examines the impact of board characteristics and sector membership on disclosure (Barako et al., 2006; Donnelly and Mulcahy, 2008; Al-Shammari and Al-Sultan, 2010; FriasAceituno et al., 2013; Vitolla et al., 2020b; 2020b) this study is grounded on agency theory as formulated by Jensen and Meckling (1976). According to agency theory, when a principal delegates responsibilities to an agent, a contractual relationship is established to achieve outcomes that are favorable to the principal. However, the division of labor can result in information asymmetry, which can have detrimental consequences. To mitigate this issue, agency theory employs various methods and tools, including disclosure of information, to bridge the gap between managers and shareholders. To demonstrate their commitment to responsible business practices and risk management, firms and managers can provide high-

quality non-financial information, particularly ESG aspects. Therefore, the board plays a crucial role in monitoring and controlling management activities, reducing agency costs, and aligning interests (Fama and Jensen, 1983; Jensen and Meckling, 1976).

Academic research suggests that boards of directors can benefit from diversity in multiple aspects, such as informational and social diversity (Jehn, 1995). Academic studies indicate that diversity in decision-making is highly valued (Post et al., 2011), with gender diversity being the subject of much academic debate (Frias-Aceituno et al., 2013; Alfiero et al., 2017). Several studies have emphasized that women on boards of directors bring valuable experiences, skills, education, values, and commitment to creating a supportive workplace (Feingold, 1994; Hofstede, 2010; Huse and Solberg, 2006). In addition, research has suggested that women directors are more ethical and moral than men, and their presence is positively correlated with CSR (Bernardi et al., 2006; Bear et al., 2010). Gender diversity on boards also improves disclosure practices, particularly related to ESG disclosure (Barako and Brown, 2008; Bear et al., 2010).

Moreover, disclosure practices also benefit from independence. Donnelly and Mulchay (2008) found that non-executive directors increase disclosure. López and Rodrigues (2007) suggest that non-executive directors aim to protect their reputation by advocating transparency. Further studies have highlighted the importance of non-executive directors in improving oversight (Dunn and Sainty, 2009), enhancing the company's relationship with its environment (Garegnani et al., 2015), and addressing stakeholder demands (Johnson and Greening, 1999; Michelon and Parbonetti, 2012; Torchia and Calabrò, 2015), including disclosure of CSR (Biswas et al., 2018) and ESG issues (Cucari et al., 2018).

Vitolla et al. (2020c) propose that a larger board may have more diversity in experience, perspective, gender, and education, leading to increased efficiency. The evidence supports this idea, as a larger board provides access to a broader range of expertise (Hidalgo et al., 2011) and greater diversity in experience, skills, and opinions (Domínguez and Gamez, 2014; García Sánchez et al., 2011), which can improve efficiency and effectiveness of operations (Gandía, 2008) and result in better disclosure policies and greater transparency (Adams and Flynn, 2005; De Villiers et al., 2011).

Board age has been identified as a measure of experience by Anderson et al. (2004) and Giannarakis (2014), but it is unclear whether council age or education level is a better indicator of council experience. Hafsi and Turgut (2013) argue that

board members' ages negatively affect CSR performance, while Bantel and Jackson (1989) and Bilimoria and Piderit (1994) found the opposite. Post et al. (2011) found that ESG disclosure decreases with average board age.

Frias-Aceituno et al. (2013) and Lipton and Lorsch (2013) found that board meetings increase board activity and disclosure, while Xie et al. (2003) argue that more board meetings improve corporate control and oversight, and Kanagaretnam et al. (2007) showed that they reduce information asymmetry. Banghøj and Plenborg (2008) found a positive correlation between board meeting frequency and information disclosure, while Brick and Chidambaran (2010) suggest that managers may benefit from more annual board meetings.

The literature is divided on whether board tenure affects disclosure levels. According to Vafeas (2003), a long-lived board provides a better understanding of the company and its business environment changes, while Berberich and Niu (2011) found that a lack of effective management oversight has negative consequences for governance. Long-term relationships between boards and executives can increase agency problems and decrease the board's oversight function over executives (Byrd et al., 2010). Long tenure indicates experience, ability, and competence, which can make the board more critical (Bebchuk et al., 2005) and increase director interaction and information exchange (Rutherford and Buchholtz, 2007).

Industry affiliation has a significant impact on corporate disclosure practices, as evidenced by the findings of Bozzolan et al. (2003), who observed variations in the reporting of intellectual capital (IC) among Italian financial statements from different industries. The expectations of stakeholders also differ across industries, leading to diverse disclosure practices, as noted by Holder-Webb et al. (2008), Deegan and Gordon (1996), and Overfelt (2010).

Research and development (R&D) spending typically accounts for more than half of a company's technological investment according to Hall (2009). R&D-intensive companies possess unique intangible assets, and their intangibility leads to increased agency costs. Due to the ever-changing business environment, companies are often reluctant to disclose their R&D project information to avoid spillovers.

Lastly, Carpenter and Petersen (2002), Aghion et al. (2004), Brown and Petersen (2009), and Belloc et al. (2016), among others, have pointed out the relationship between high-tech industries with significant R&D expenditures and severe agency issues and their related costs.

In light of this, the following hypotheses are made:

H1 The level of ESG disclosure is positively influenced by board diversity;

H2 The level of ESG disclosure is positively influenced by board independence;

H3 The level of ESG disclosure is positively influenced by board size;

H4 The level of ESG disclosure is negatively influenced by board average age;

H5 The level of ESG disclosure is positively influenced by board meetings frequency;

H6 The level of ESG disclosure is positively influenced by board tenure;

H7 The level of ESG disclosure is positively influenced by high-tech industry membership.

4 Methodology

4.1 Sample

To explore the impact of governance variables and high-tech industry membership on ESG disclosure quality a sample of 1221 international firms was initially obtained from Bloomberg, but due to missing data on both dependent and independent variables, the final sample size was reduced to 864 firms.

4.2 Dependent variable

In line with previous literature on ESG disclosure (Giannarakis et al., 2014; Fatemi et al., 2018; Raimo et al., 2021; Wong et al. 2021; Huang et al., 2022, and Chung et al., 2023), Bloomberg's ESG Disclosure Index evaluates and measures ESG disclosure levels of banks using a proprietary scoring methodology. It examines ESG-related information presented in relevant documents and focuses on crucial ESG issues such as labor standards, climate change, human rights, and corporate governance. The ESG Disclosure Score (ESGDS) is calculated using 100 out of 219 data points and ranges from 0 to 100, with higher scores indicating more comprehensive ESG information. The score is weighted to emphasize commonly disclosed information and normalized based on industry requirements. The index is a useful tool for investors and stakeholders to evaluate a company's ESG performance and risks.

4.3 Independent variables

To test the seven hypotheses, we will examine seven distinct independent variables, namely:

- Board diversity (BDD) is a measure of the percentage of women on the board, as defined by previous studies conducted by Frias-Aceituno et al. (2013), Liao et al. (2015), Alfiero et al. (2017),
- Board Independence (BDI) is calculated as the percentage of independent board members, based on previous research by Frias-Aceituno et al. (2013) and Vitolla et al. (2020c);
- The size of the board (BDS) is determined by the number of members present on the board, as established in earlier studies by Frias-Aceituno et al. (2013) and Vitolla et al. (2020b);
- Board average age (BAG) is the average age of directors on the board, as measured by Bueno et al. (2018), Martikainen et al. (2019), and Nour et al. (2020);
- Board meetings frequency (BFQ) is the number of annual meetings of the board of directors, as calculated by Frias-Aceituno et al. (2013) and Vitolla et al. (2020b);
- Board tenure (BAT) is the tenure of directors on the board, as measured by Kim et al. (2014);
- High-Tech Industry membership (HTI), is measured through a dummy variable whit value 1 if the company operates in high-tech sectors and 0 otherwise. According to Bozzolan et al. (2006) as high-tech sectors, we refer to biotechnology, entrainment, Internet, IT distribution, high-tech manufacturing, software, system integration and telecommunication, web services, and we include healthcare.

4.4 Control variables

The present study incorporates control variables to enhance the reliability and validity of the regression model. To this end, firm size (FSIZE) is quantified using the natural logarithm of total assets and financial leverage (LEV) is calculated as the ratio of total debt to total assets.

4.4 Model

To assess the impact of the independent variables on ESG disclosure quality, we used a regression model with a cross-sectional design. We chose this approach over a panel analysis because there is limited variation in both the dependent and independent variables over time (Bavagnoli et al., 2018). The analysis is represented by the following equation:

$$ESGD = \beta_0 + \beta_1 BDD + \beta_2 BDI + \beta_3 BDS + \beta_4 BAG + \beta_5 BFQ + \beta_6 BAT + \beta_7 HTI + \beta_8 FSIZE + \beta_9 LEV + \varepsilon$$

5 Results and discussion

5.1 Descriptive statistics, VIFs and correlation analysis

Table 1 displays the results of the descriptive analysis of the variables. The dependent variable, ESG disclosure quality (ESGD), exhibits a moderate level of disclosure, with an average value of 56.62. The ESGD score ranges from 21.33 to 85.70, indicating a significant variation in disclosure quality among the sampled firms. The independent variables provide insightful considerations. The sampled firms demonstrate a modest degree of diversity in their boards (BD), with an average of 3.61% of women, a maximum of 11%, and a troubling minimum of 0%. In terms of board independence (BDI), the results are diametrically opposed, with an average value of 76.66%, a minimum of 11.11%, and a maximum of 100%. On average, the sampled firms have boards comprising 11 members, with a range of 5 to 24 members. The average age of board (BAG) members is 61.46 years, with the youngest board averaging 40.88 years and the oldest 77.93 years. The boards convene approximately 10 times per year, with a minimum of 2 and a maximum of 48 meetings, and hold office for an average of 7.23 years, with a minimum of 1.14 years and a maximum of 22.94 years. Notably, 30% of the companies in the final sample belong to the high-tech sector (HTI).

Table 1 – Statistical summary of the variables

Variables	Obs.	Mean	Std. dev.	Min.	Max
ESGD	863	56.62	10.68	21.33	85.70
BDD	863	3.61	1.62	0	11
BDI	863	76.66	18.77	11.11	100
BDS	863	11.19	2.72	5	24
BAG	863	61.46	4.18	40.88	77.93
BFQ	863	9.70	4.94	2	48
BAT	863	7.23	3.10	1.14	22.94
HTI	863	0.30	0.45	-	-
FSIZE	863	10.90	1.99	7.33	20.31
LEV	863	6.43	27.63	1.02	709.5

Pearson's correlation analysis was used to understand the relationship between governance dimensions, ESG disclosure, and control variables. The results are presented in Table 2. There was no evidence of significant multicollinearity, with the highest correlation coefficient of 0.6651 between BDD and BDS. Farrar and Glauber (1967) stated that harmful levels of multicollinearity occur when the correlation coefficient reaches ±0.8 or ±0.9. A variance inflation factor (VIF) analysis was also conducted to assess the potential multicollinearity between the explanatory variables, and the results are shown in Table 2. The VIFs range from 1.01 to 2.14, with an average value of 1.43. According to Myers (1990), if any VIFs are less than 10, multicollinearity is not a significant concern in the regression model.

Table 2 –VIFs and Pearson's correlation coefficients

Variables	VIF	ESGD	BDD	BDI	BDS	BAG	BFQ	BAT	HTI	FSIZE	LEV
ESGD		1									
BDD	2.03	0.1999***	1								
BDI	1.26	0.0906***	-0.0828**	1							
BDS	2.14	0.1886***	0.6651***	-0.2063***	1						
BAG	1.37	-0.0101	-0.1352***	0.2753***	0.0110	1					
BFQ	1.22	0.0721**	0.0411	-0.1315***	0.0067	-0.0996***	1				
BAT	1.44	-0.2876***	-0.1740***	0.0057	-0.0327	0.3829***	-0.2994***	1			
HTI	1.01	0.2354***	-0.0289	0.0626*	-0.0427	-0.0123	0.0131	-0.0606*	1		
FSIZE	1.39	0.1416***	0.0254	-0.2514***	0.2341***	0.0111	0.3412***	-0.2483***	-0.0198	1	
LEV	1.01	-0.0500	0.0088	-0.0309	0.0107	0.0201	0.0018	0.0380	-0.0680**	0.0222	1

5.2 Multivariate analysis results and discussion

The hypotheses were tested using a multiple linear regression model. The results of these analyses are summarized in Table 3. This table shows the results of the regression coefficients for all independent variables using ESG disclosure as the dependent variable.

Table 3 – OLS regression model results

Variables	*Coefficient*	*Standard Error*	*p-value*	*Sign.*
Cons	35.488	4.985	0.000	***
BDD	0.549	0.291	0.060	*
BDI	0.062	0.019	0.002	***
BDS	0.531	0.177	0.003	***
BAG	0.156	0.082	0.060	*
BFQ	-0.044	0.073	0.544	
BAT	-0.919	0.127	0.000	***
HTI	5.145	0.728	0.000	***
FSIZE	0.408	0.195	0.037	**
LEV	-0.012	0.012	0.286	

Notes:
n = 864
Adj R2 = 18.19
***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

The adjusted R-squared score of 0.1819 means that the model can account for 18.1% of the variability of the dependent variable.

The results support hypothesis 1 (H1). Board diversity (BDS) shows a significantly positive association with ESG disclosure at p = 0.060, suggesting that firms with a higher percentage of women on the board of directors are more likely to disclose ESG information. This may be due to women's tendency to prioritize social responsibility and ethical decision-making, as well as their greater commitment and involvement in board activities (Liao et al., 2015). Moreover, the presence of women on the board is associated with best practices and a positive working environment, which may further encourage companies to be transparent in their ESG reporting. Our findings contribute to the existing literature on the positive relationship between board diversity and social disclosure (García-Sánchez et al., 2014; Verbeeten et al., 2016; Hussain et al., 2018).

The results support hypothesis 2 (H2). Board independence (BDI) shows a significantly positive association with ESG disclosure at p = 0.002, suggesting that firms with a higher percentage of independent members on the board of directors are more likely to disclose ESG information. Non-executive members play a crucial role in monitoring company activities and satisfying stakeholder demands, while also safeguarding the interests of minority shareholders (Birindelli et al., 2018; Elmagrhi et al., 2019; Chintrakarn et al., 2020). As such, companies with a greater proportion of non-executive members are more likely to disclose their ESG information, leading to greater transparency. These results extend previous research on the positive impact of board independence on ESG disclosure (Oliveira et al., 2011; De Villiers and Hsiao, 2018; Chijoke-Mgbame et al., 2020).

The results support hypothesis 3 (H3). Board size (BDS) shows a significantly positive association with ESG disclosure at p = 0.002, suggesting that firms with a larger board of directors are more likely to disclose ESG information. Larger boards have a greater range of skills and experiences, which can lead to more effective problem-solving and decision-making. This in turn can lead to greater disclosure of both financial and non-financial information, including ESG data. Our findings contribute to the existing literature on the importance of transparency in corporate reporting (Godos-Dìez, 2018; Lagasio and Cucari, 2019; Velte, 2021) and highlight the role of board size in facilitating ESG disclosure.

The results do not support Hypothesis 4 (H4); although the relationship between board average age (BAG) and ESG disclosure is significant it is positive and shows that, among the sampled firms, those characterized by older boards are more likely to disclose ESG information. It is worth noting that boards with a higher average age may be more attuned to ESG issues due to their experience of witnessing society's evolving attitude towards sustainability and corporate social responsibility. These board members may also be able to provide a long-term strategic vision of the company, including the importance of addressing ESG concerns to ensure the company's sustainability, protect its reputation, and attract investors.

The results do not support Hypothesis 5 (H5); the impact of board meeting frequency (BFQ) on ESG disclosure is not statistically significant. This dimension seems not to be related to a higher level of Environmental, Social, and Governance (ESG) disclosure.

The results do not support Hypothesis 6 (H6); although the relationship between board average tenure (BAT) and ESG disclosure is significant it is negative and shows that, among the sampled firms, those characterized by board in charge for longer are less likely to disclose ESG information. Long-serving board members may be influenced by personal relationships or vested interests, leading to a lack of transparency in sharing information and reluctance to disclose information that may reveal organizational problems.

The results support hypothesis 7 (H7). The high-tech industry membership (HTI) shows a significantly positive association with ESG disclosure at $p = 0.000$ and a very strong impact of 5.145, suggesting that firms with a higher level of technologies are more likely to disclose ESG information. Companies in the high-tech industry have better access to data due to advanced technologies such as data analytics and artificial intelligence, allowing them to collect, analyze, and present ESG information more efficiently. Additionally, they face greater investor pressure and increased awareness of ESG risks and opportunities. These results align with previous studies by Hsu and Chang (2011), who noted that companies in highly knowledge-based industries such as high-tech are more likely to disclose intangible assets due to their importance to shareholder value. Furthermore, agency theory suggests that companies with higher levels of intangible assets will increase their level of disclosure to address information asymmetry with external stakeholders, as pointed out by Biscotti and D'Amico (2016).

Finally, the results reveal that among the two control variables (SIZE, and LEV), only firm size has a positive and significant impact on the level of ESG information disclosed by banks.

6 Conclusions

This study investigates the influence of board characteristics namely diversity, independence, size, average age, meeting frequency, tenure, and high-tech industry membership on the quality of ESG disclosure using agency theory as theoretical lens. We analyze a sample of 864 international companies and find that diversity, independence, board size, average age, and high-tech sector membership have a positive effect on ESG disclosure quality. However, board tenure has a negative impact, and meeting frequency has no significant relationship.

Our study has significant implications for practitioners and policymakers. Practitioners and corporate managers should consider redesigning their boards to foster ethical behavior and increase ESG disclosure quality. Specifically, incorporating more non-executive and female board members can improve ethical behavior and increase ESG disclosure quality.

Our study extends the application of agency theory by providing a holistic and international view of governance's role in ESG disclosure quality. Moreover, it confirms that financial disclosure is a crucial aspect for sectors with higher R&D expenditures, and digital technologies are indispensable for improving sustainability reporting quality. Policymakers who prioritize sustainability can take a cue from high-tech sectors that have demonstrated effective sustainability reporting practices. At the onset of the European Union's latest Corporate Social Responsibility Directive (CSRD), these findings assume a heightened significance as they offer valuable insights for policymakers, regulators, and business managers alike.

Although this study contributes valuable insights, it is important to acknowledge its limitations. Firstly, the methodology used is based on a cross-sectional design rather than a longitudinal panel approach, which may have implications for the robustness of the findings. Additionally, certain board characteristics used in the analysis may be subject to limitations. Lastly, high-tech technologies have been operationalized solely in terms of sector membership, which may not capture the full extent of their impact on corporate governance.

Despite these limitations, this study provides a foundation for future research. For instance, future studies could adopt a longitudinal approach to investigate this phenomenon over several years, allowing for a more nuanced understanding of the relationships between board characteristics, high-tech technologies, and disclosure quality. Additionally, future research could explore the impact of other factors related and unrelated to governance aspects, such as firm size, industry, and ownership structure, and also the impact of different technologies on the disclosure quality.

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Using Workshop-Based Elicitation of Business Requirements for Co-Creation: An Integrative Approach for Capturing Tacit Knowledge

Michal Krčál*

Masaryk University
Lipová 507/41a, 602 00 Brno (Czech Republic)

Mikhail Monashev

Masaryk University
Lipová 507/41a, 602 00 Brno (Czech Republic)

Ahad Zareravasan

Masaryk University
Lipová 507/41a, 602 00 Brno (Czech Republic)

* *Corresponding author*

Abstract

Well-conducted requirements engineering (RE) activities account for a significant share of success in IT projects (Wiegers and Beatty, 2013). The RE process starts with identifying business objectives that define a context for eliciting business requirements. Because RE is considered a social interaction (Serna et al., 2017), a share of knowledge about business requirements is stored as unarticulated tacit knowledge possessed by individuals within an organization (Boyer and Mili, 2011). This personalization of tacit knowledge causes barriers to gathering valid requirements (Serna et al., 2017). Moreover, intra-organization knowledge sharing is often complicated by knowledge hiding (Connelly et al., 2012), resulting from a lack of interpersonal trust between employees and (external) analysts (Holste and Fields, 2010). In Knowledge Management (KM) literature, tacit knowledge sharing is mainly discussed from the cultural and psychological perspectives (Chen et al., 2018; Holste and Fields, 2010), which are out of the control of an external business analyst. However, some publications suggested specific methods and tools that business analysts can use to foster requirements elicitation, such as creating engaging environments (Nakano et al., 2013) and utilizing social web-based tools (Panahi et al., 2016, 2013). Although a large amount of focus in KM and RE was dedicated to knowledge and requirements elicitation, we see little integration of KM-based tools and techniques in RE.
Therefore, in this paper, we draw on our experience facilitating a co-creation workshop to help other facilitators effectively deal with collecting tacit knowledge about the business

requirements in organizations. We started with a systematic literature search in two areas (knowledge and requirements elicitation) and identified one review for each area that lists elicitation methods (Anwar et al., 2022; Gavrilova and Andreeva, 2012). We used conceptualization of the identified methods to design a workshop. After the workshop facilitation, we reflected on our data from participatory observation and suggested recommendations for similar workshops. We addressed several issues that emerged during the workshop, namely (i) insufficient domain knowledge before the workshop, (ii) lack of validation, and (iii) issues with capturing tacit knowledge during the workshop.
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Keywords – Requirement; knowledge; elicitation; co-creation; embedded knowledge.

Paper type – Academic Research Paper

1 Introduction

Applied or experimental research, software development, policy design, and other fields use co-creation workshops as a primary "method" for requirements elicitation. Many Horizon Europe research proposals contain co-creation workshops; however, the concept of this activity is not clear nor universally understood. It can range from simple discussion or brainstorming to complex methodology. Well-conducted requirements engineering (RE) activities account for a significant share of success in IT projects (Wiegers and Beatty, 2013). The RE process starts with identifying business objectives that define a context for eliciting business requirements. Because RE is considered a social interaction (Serna et al., 2017), even if most of the knowledge is documented, a share of knowledge about business requirements is stored as unarticulated tacit knowledge possessed by individuals within an organization (Boyer and Mili, 2011). This personalization of tacit knowledge causes barriers to gathering valid requirements (Serna et al., 2017). Moreover, intra-organization knowledge sharing is often complicated by knowledge hiding (Connelly et al., 2012), resulting from a lack of interpersonal trust between employees and (external) analysts (Holste and Fields, 2010), causing problems in project consortia where industrial partners are present.

Standard requirements-gathering techniques such as interviews, questionnaires, user observation, workshops, brainstorming, use cases, role-playing, and prototyping could increase the chances of gathering the correct

requirements (Ribeiro et al., 2014). In knowledge management (KM) literature, tacit knowledge sharing is mainly discussed from the cultural and psychological perspectives (Chen et al., 2018; Holste and Fields, 2010), which are out of the control of an external business analyst. However, some publications suggested specific methods and tools that can potentially be used by business analysts, such as creating engaging environments (Nakano et al., 2013) and utilizing social web-based tools (Panahi et al., 2016, 2013). Although KM researchers focused much on knowledge capture and sharing, we see little integration of KM-based tools and techniques in RE.

Focusing on tacit aspects of knowledge is essential when eliciting business requirements. Yet little direct attention was paid to integrating techniques, tools, and methods from the RE field into KM or vice-versa. Therefore, in this paper, we used an opportunity of working on the Horizon Europe project called DiCiM[1] and compared the typical methods from both fields. We developed a design of a co-creation workshop for business requirements elicitation, facilitated the workshop, and reflected on data from our observations to derive recommendations for facilitating similar workshops in the future.

2 Theoretical Background

Overlap between the knowledge and requirements elicitation is not very thoroughly investigated. When searching for the keywords *knowledge*, *requirements*, and *elicitation* in a title, we found only nine relevant articles on the Web of Science that focus on this matter. Our understanding of the concepts we investigated is as follows.

Requirements elicitation is a process of understanding a problem and its application domain. The requirement elicitation aims to identify as many requirements as possible to prepare several alternate solutions for the stated problem (Khan et al., 2014). Business requirements elicitation techniques provide means to discover the issues, problems, opportunities, and needs of the users by the systems analysts. After it, systems developers can design the solution to solve the issues or leverage the opportunities (Gobov and Huchenko, 2020).

Knowledge elicitation (also referred to as 'knowledge acquisition') is conceptualized as an interaction between analyst and expert, aiming to capture

1Digitalised Value Management for Unlocking the potential of the Circular Manufacturing Systems with integrated digital solutions (www.dicimproject.eu)

and validate the knowledge of the latter (Gavrilova and Andreeva, 2012; Schreiber et al., 1999). Primary methods such as interviews, observation, storytelling, and brainstorming (Gavrilova and Andreeva, 2012) aim at externalizing expert knowledge in the form of knowledge objects. Simultaneously, secondary methods such as cognitive mapping (Kwong and Lee, 2009) establish links between earlier elicited knowledge objects. Although both fields are very close together, requirements elicitation does not always have to cover tacit knowledge.

When knowledge needs to be elicited to identify, document, and analyze requirements, a business analyst must overcome a barrier of personalization of tacit knowledge (Serna et al., 2017). The ambiguity of elicited requirements, mainly driven by differing stakeholders' views, can cause project failure (Anwar et al., 2022). Because the tacit part of requirements consists of intuition and inspiration and depends on an individual's analytical abilities, reflections, experience, and creativity (Al-Alshaikh et al., 2020), it is crucial to make it as easy for the stakeholders as possible.

Therefore, method(s) selection for elicitation is crucial, and the choice needs to be situational (Mishra et al., 2018). For this purpose, an evaluation framework was developed (see Mishra et al., 2018). However, the framework lacks detail because it uses a shallow granular approach to categorizing the methods. It allows the business analysts to be aware of available options but does not help them to design the elicitation phase.

3 Methodology

We followed the idea of the design research (Peffers et al., 2007) methodology for designing a co-creation workshop aimed at eliciting business requirements. To achieve this purpose, we took the following steps. First, we systematically searched for literature following Tranfield et al. (2003) approach. We identified a list of methods for eliciting tacit knowledge in general and business requirements as a specific type of tacit knowledge. Second, we conceptualized and evaluated the identified techniques based on their applicability to co-creation workshops. Third, we designed and conducted the workshop. Last, we used the first phase of action research (Baskerville and WoodHarper, 1996; Mansell, 1991) to evaluate and reflect on the implementation of the workshop.

In a systematic literature search, we aimed to identify peer-reviewed literature reviews dedicated to the elicitation techniques in KM and RE. First, we queried

reviews in the KM field by using the combination of the following keywords: ("knowledge elicitation") AND ("techniq*" OR "tool*" OR "method*") AND ("review") AND ("knowledge management"). This search yielded two reviews; however, we only considered the one by Gavrilova and Andreeva (2012) after the abstract screening relevant.

The second query we applied during the literature search was focusing on elicitation techniques in the field of Requirements Engineering and thus combined the following keywords: "requirement*" AND "elicit*" as the title, and "knowledge" AND "review" as the topic. Then, during the abstract screening, we included one paper (Anwar et al., 2022) since it provided the most extensive review of the tools and techniques of requirements elicitation.

In the next step, we conceptualized elicitation techniques specified in both reviews using context-aware backward search. Subsequently, we compared the identified techniques and selected those that matched our co-creation workshop's goals. Then, aligned with the design research principles (Peffers et al., 2007), we used this knowledge to design a co-creation workshop. Subsequently, we facilitated a two days workshop in a company preceded by a site visit. The workshop aimed to elicit business requirements for a digital technology development project. The workshop consisted of three facilitators and six stakeholders, and key users. Using participatory research and observations, we reflected on the observations of the workshop on the design and drew recommendations and conclusions.

4 Design of a co-creation workshop

We started by identifying typical methods used during the elicitation. As was stated earlier, we used two review papers to establish a list of methods. For KM methods, we used Gavrilova and Andreeva's (2012) taxonomy of primary knowledge elicitation methods (see Figure 1). For RE methods, we used a review study by Anwar et al. (2022) listing RE techniques (see Table 1). A comparison between the two sets of techniques is summarized in Table 2. The rest of this section conceptualizes the techniques.

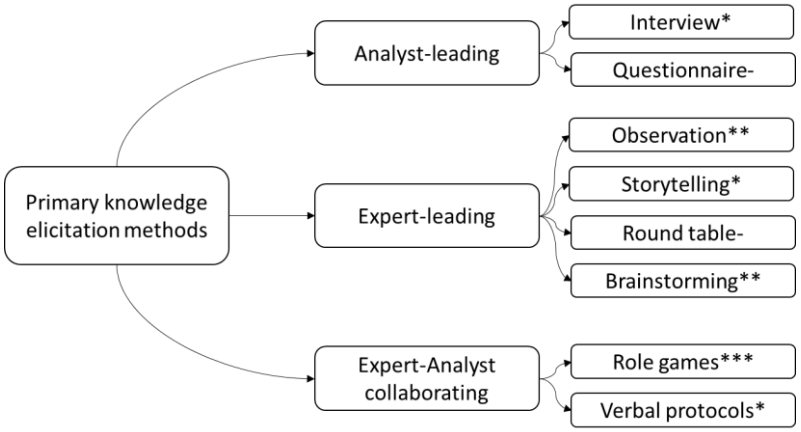

*Figure 1: Taxonomy of knowledge elicitation techniques (adapted from Gavrilova and Andreeva, 2012). Notes: *May work, **Is appropriate, ***Is very suitable, - Not applicable.*

Gavrilova and Andreeva's (2012) taxonomy outlines eight techniques for knowledge elicitation: (i) interview, (ii) questionnaire, (iii) observation, (iv) storytelling, (v) round table, (vi) brainstorming, (vii) role games, and (viii) verbal protocols. In addition, in their review, the authors mention the inapplicability of round tables for tacit knowledge elicitation, which puts this technique beyond the scope. Although the authors also referred to questionnaires as inapplicable, we considered them in our analysis since, unlike round tables, questionnaires can be used before the workshop to improve preparation. Moreover, the authors mention cognitive mapping as a secondary technique for tacit knowledge elicitation.

Table 1: List of requirements elicitation techniques sorted by frequency of mentioning in the literature (adapted from Anwar et al. (2022)

ID	Technique	Frequency
1	Interview - closed and open	79.31%
2	Questionnaire	72.41%
3, 4, 5, 6	Observation (including Ethnography, Social Analysis, and Active Observation)	72.41%
7, 8	Prototyping (also referred to as Joint Application Development)	68.96%
9	Brainstorming	68.96%
10	Scenarios	65.51%
11, 12, 13	Benchmarking (including Similar Systems, Requirement Reuse, and Application Analysis)	55.17%

14	Card Sorting	44.82%
15, 16	Protocol Analysis (also referred to as Think Aloud)	41.13%
17	Repository Grids	24.13%

In their review, Anwar et al. (2022) identified seventeen techniques applicable to requirements elicitation, with interviews, questionnaires, and observation being the most frequently used ones. Moreover, Anwar et al. (2022) mentioned document analysis as one of the techniques. It is worth mentioning that repository grids, the less frequently mentioned technique, was discarded in the process of conceptualization.

Table 2: Techniques for tacit knowledge and requirements elicitation

Tacit Knowledge Elicitation (Gavrilova and Andreeva, 2012)	**Requirement Elicitation (Anwar et al., 2022)**
Interview	Interviews – closed and open
Observation	Observation (including Ethnography, Social Analysis, and Active Observation)
Storytelling	N/A
Brainstorming	Brainstorming
Role games	Scenarios
Verbal protocols	Protocol Analysis (also referred to as Think Aloud)
N/A	Prototyping (also referred to as Joint Application Development)
N/A	Benchmarking (including Similar Systems, Requirement Reuse, and Application Analysis)
Cognitive maps (mentioned)	Card sorting

Although most of the techniques are applied in both fields, storytelling was explicitly mentioned by Gavrilova and Andreeva (2012), while prototyping, benchmarking, and document analysis were outlined only by (Anwar et al., 2022).

4.1 List of elicitation techniques

As summarized in Figure 2, with relation to the use of the techniques for a workshop, all the identified elicitation techniques can be split into three categories based on the moment when they are to be applied: (i) pre-workshop, (ii) on-workshop, and (iii) post-workshop.

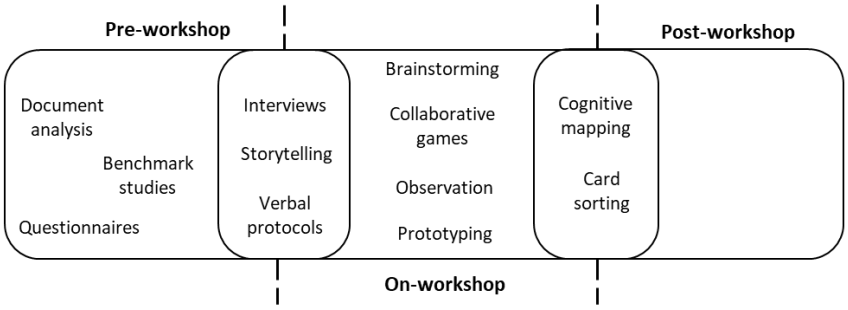

Figure 2: Elicitation techniques suitable for co-creation workshop design

Pre-workshop techniques aim at collecting evidence before the workshop and helping analysts develop on-site content. These techniques include (i) document analysis, (ii) benchmark studies, and (iii) questionnaires.

Document analysis is an approach that is used to elicit business analysis information, including contextual understanding and requirements (Gobov and Huchenko, 2020; Khan et al., 2014). It examines available documents that describe the business environment or organizational settings. Document analysis may be used to gather background information to understand the context of a business need. It may include researching existing solutions to validate their current implementation. Document analysis can validate findings from other elicitation efforts, such as interviews and observations. Document analysis involves gathering information from existing documentation and could involve interaction with a human expert to confirm or add to this information (Gobov and Huchenko, 2020; Khan et al., 2014).

Benchmark studies help analysts to compare organizational practices against the market best practices. During benchmarking, similar systems or applications could be analyzed. Sometimes, benchmarking is accompanied by a market analysis that studies customers to discover the products and services they need, the determinants of their purchase decision, and the competing companies, products, or services in the market (IIBA, 2015).

Questionnaires aim at the quick collection of information from many respondents. Respondents can represent a diverse (often dispersed) population that can be easily reached and relatively cheaply (Gobov and Huchenko, 2020; Paul et al., 2014; PMI, 2017).

On-workshop techniques aim at collecting evidence on-site and involve collaboration between an analyst and, typically, multiple experts. These

techniques include (i) brainstorming, (ii) collaborative games, (iii) observation, and (iv) prototyping.

Brainstorming is a technique to quickly identify a list of ideas (e.g., a list of risks, problems, business objectives, or potential solution options). Brainstorming is conducted in a group environment and is led by a facilitator. The group generates as many ideas as possible about the topic during a brainstorming session (IIBA, 2015; PMI, 2017).

Collaborative games foster collaboration, innovation, and creativity to achieve the goal of the elicitation activity. Gameplays are used to encourage team participation and enhance engagement. It helps the participants share their knowledge and experience on a given topic, identify hidden assumptions, and explore that knowledge in ways that may not occur during regular interactions. The shared experience of the collaborative game encourages people with different perspectives on a topic to work together to understand an issue better and develop a shared model of the problem or potential solutions (IIBA, 2015; PMI, 2017).

Observation provides a direct way of collecting information about how a business process is performed by observing it in a natural practical environment (Gobov and Huchenko, 2020; IIBA, 2015; Zhang, 2007). It provides means to develop a rich understanding of the application domain by observing human activities. In addition to non-tacit requirements, some are apparent to stakeholders but challenging to verbalize. We call them tacit requirements. This technique is helpful when process owners cannot share their expertise through other models due to the lack of time or difficulties expressing ideas and working practices. In addition, this method is used to understand complex societies rather than judge how ways of working could be improved or supported (Gobov and Huchenko, 2020; IIBA, 2015; Zhang, 2007).

Prototyping elicits and validates requirements through an iterative process that creates evolutionary models or designs of requirements or is used to model user experience, evaluate design options, and as a basis for developing the final business solution (Paul et al., 2014). Prototyping is an iterative process and part of the analysis phase of the system development life cycle, which helps get feedback from the users, as users can see facilities and provide a response (Khan et al., 2014). The system analysts can evaluate the response, modify the existing requirements, and develop new ones (IIBA, 2015).

Three techniques, namely, interviews, storytelling, and verbal protocols, require one-to-one interaction between an analyst and an expert (Gavriolova and Andreeva, 2012) and, therefore, can be implemented in both phases: pre-workshop (in online format) and on-workshop.

An interview is a formal or informal approach to elicit stakeholder information. It is performed by asking prepared questions and documenting the responses. Interviews are often conducted individually between an interviewer and an interviewee but may also involve multiple interviewers and interviewees. Questions that arise during the conversation can be discussed immediately, and the requirements engineer may uncover subconscious requirements through thoughtful questions (PMI, 2017; Pohl, 2010). An interview is a dialogue between an analyst and an expert. An analyst asks an expert several questions that can either be pre-defined (in structured interviews) or emerge in the interview process (in unstructured interviews).

Storytelling is considered one of the forms of interviews, where most of the structuring is left up to an expert, while analyst just sets the direction of this structuring as in the example below (Scheibelhofer, 2008):

> *Could you please tell me everything that is involved in your coming to New York and how your life went on since then? I will listen and make some notes and I will not interrupt you until you have finished. Please take as much time as you feel necessary and tell me all the details you remember that, in your opinion, are connected to your living in New York.*

Verbal protocols are the last interview-based methods outlined by Gavrilova and Andreeva (2012). Verbal protocols are traditionally used in social sciences as cognitive interviewing (Willis, 2005). Experts are asked to "think aloud" in cognitive interviewing and reveal their decision-making process to an analyst.

Finally, two techniques applicable for the on-workshop and post-workshop phases include: (i) cognitive mapping and (ii) card sorting.

Cognitive mapping is a technique suitable for the on-workshop and post-workshop phases. Once an expert's knowledge is elicited, an analyst might synthesize it as cognitive maps that validate the results of knowledge elicitation with experts (Kwong and Lee, 2009). A cognitive map puts all the fragments of the elicited knowledge in one space and defines relations between them.

Card sorting is a technique used to sort various knowledge objects. Participants are asked to organize individual, unsorted items into groups. Card sorting may be conducted as a series of individual exercises, as a concurrent

activity of a small group, or as a hybrid approach where individual activity is followed by a group discussion of individual differences (Tiwari et al., 2012).

4.2 Workshop design

While designing our workshop, we had limited access to the industrial partner representatives (i.e., users of future solutions). The only pre-workshop interaction we had with stakeholders was an 80-minutes interview, where we aimed to establish an understanding of a problem domain. Afterward, the stakeholders had minimal time to validate our understanding, which decreased the "active" workshop time.

Because not a single method can solve all the problems of requirements elicitation (Mishra et al., 2018), we employed several methods in our workshop design. Since we lacked an understanding of the problem domain, we needed to start the workshop by gathering data about the processes. Therefore, we organized a site visit to observe how the processes that are part of the requirement elicitation were executed.

The next day, we needed to capture the roles and needs of the relevant stakeholders. Therefore, we used parallel sessions where each workshop facilitator did storytelling (narrative interviews) with a stakeholder. Storytelling helped us to structure the subsequent sessions.

In the next session, we combined individual and group brainstorming techniques. First, we let each stakeholder compile a list of problems that could help the company. Then, the lists were swapped with another stakeholder who reviewed them and commented on them with their thoughts. We debriefed this session by creating a cognitive map that synthesized and summarized the brainstorming session.

In the subsequent activity, we worked with the cognitive map and used group brainstorming to develop potential solutions for tackling the identified problems. Each solution was taken for detailed scrutiny. For this, we used a combination of techniques consisting of scenarios, thinking aloud, and comparison to similar systems to create further cognitive maps as session outputs.

5 Evaluation of the design

Our workshop encountered several problems that caused time management issues and lower quality of elicited requirements. The most significant problems

were: (i) insufficient domain knowledge before the workshop, (ii) lack of validation during the workshop, and (iii) issues with capturing tacit knowledge.

First, we lost a significant amount of time at the beginning of the workshop since it was dedicated to storytelling. Although storytelling sessions helped to improve facilitators' understanding of a problem domain, which they lacked due to the restrictions in the workshop preparation phase, it decreased the time available for other sessions (e.g., going deeper with individual requirements and features). Therefore, to address this issue in future workshops, we will substitute on-workshop storytelling with pre-workshop interviews.

Second, the post-workshop validation did not show to be of sufficient level. Cognitive maps are helpful for visualizations but sometimes lack explicitness and essential detail. We waited for the validation after the workshop when we finished the transcription of the sessions and developed a RE draft. Validating the document without properly validating outputs from the individual sessions was futile as stakeholders lacked time and context of the content of the RE draft. We planned short validation sessions in our agenda, but they were sacrificed due to the extended storytelling and brainstorming sessions. We did not find a solution in the literature, which mostly omits to discuss the validation of the elicited requirements. In the next workshop, we plan to divide the roles of facilitators in the way that one facilitator will focus on moderating the discussion with industrial partner representatives. At the same time, another one will, in parallel, produce outputs, which will then be taken to a discussion during validation sessions and incorporated into the workshop agenda.

Third, although we tried to employ several KE techniques, we did not successfully capture embedded knowledge. We discovered that without proper domain knowledge, it is complicated to understand all the terms and concepts that stakeholders naturally use. Studies listing and describing elicitation techniques raise the issue of complicated capture of embedded (tacit) knowledge. However, they lack practical solutions. In the next workshop, we could solve this by developing and validating the glossary of terms that could help us better understand the subtle differences in the meaning of terms and concepts unique to each organization during the pre-workshop preparations.

To summarize, we recommend that facilitators of the co-creation workshops focus on two aspects. The first is to do as much to understand a problem domain, including a glossary of commonly used terms and abbreviations in the enterprise, before the workshop. The second is to incorporate validation sessions in the

workshop agenda. These two actions are essential to improve the quality and efficiency of business requirement elicitation.

6 Conclusion

We showed that the approaches to investigate challenges posed by embedded (tacit) knowledge in requirements engineering are being tackled in different fields. However, there were few attempts to integrate knowledge from (software) requirements engineering, knowledge management, and co-creation fields. The current knowledge is fragmented and, at the same time, overlapping across the fields. We suggest that the next step could be an integrative literature review of the relevant fields to describe the overlaps and gaps in the current knowledge precisely. Such a review could answer our study's first limitation: the restricted set of techniques. Although we used two literature reviews to generate the list of techniques, a thorough critical evaluation would likely add several methods to the list. However, we wanted to see if it is possible to identify relevant methods with a relatively small effort. In an ideal situation, a systematic literature review of methods would be more suitable for generating a robust list of techniques.

Furthermore, we suggest that the practice of requirements engineering and theoretical research should be more deeply aligned as they are decoupled. Therefore, we see the solution in employing a participative methodology. Combining design and action research seems ideal to align the practice and basic research. It covers the study's second limitation caused by trying our design only in one workshop. Before submitting this paper, we had no opportunity to facilitate another workshop and use the reflection to improve the design. We will remedy this by facilitating several workshops within the same project and thus will be able to fully use the added value of the combination of design and action research.

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Boredom as a Challenge to Knowledge Acquisition: Mapping Boredom-Inducing Elements of a Video Presentation, Using Multimodal Measurements

Judit Sass*

Institute of Education Research
University of Pannonia
H-8210 Veszprém, Egyetem u. 10.

Lídia Vinczéné Fekete

Centre for Educational Quality Enhancement and Methodology
Corvinus University of Budapest
1093 Fovam ter 8

Éva Bodnár

Institute of Education Research
University of Pannonia
H-8210 Veszprém, Egyetem u. 10.

* *Corresponding author*

Abstract

Videos are increasingly used for learning both in higher education and in organizational knowledge exchange. Though this tool enables flexible and effective individual learning, its effectiveness largely depends on its ability to maintain viewers' attention. Studies of learner attitudes towards video presentations show that they feel less engaged with digital pieces of training than before the pandemic and L&D professionals consider their virtual training experiences ineffective. As the production of instructional videos is time and resource intensive, it is essential to have a clear understanding of the factors and principles that should be taken into account when making and using this genre specifically. Our research aims to contribute to this goal with research findings and practical suggestions.
Since, to the best of our knowledge, only a little research has so far investigated the factors that influence the effectiveness of instructional videos for workplace learning (see one of these in Section 2.1.1), the current study presents some of the significant findings in the literature on the principles of the effectiveness of instructional videos supported by empirical research in different educational sectors (such as higher education, adult education, vocational training, professional or self-paced online learning). It also presents

the findings of an empirical mixed-methods study on the effectiveness and engaging capacity of instructional videos in higher education. Learner emotions (N=25) were identified by self-report questionnaires Due to the high degree of similarity between the two learning environments, these conclusions are worth being considered for workplace-based instructional videos as well.

Keywords – knowledge acquisition, boredom, instructional video, automated facial analysis, higher education

Paper type – Academic Research Paper

1 Introduction

The use of video tutorials is increasing in organizational learning: in 2020 and 2021, 91% of organizations offered virtual pieces of training (Huggett, 2021). Learners nevertheless feel less engaged with digital training than before, and 53% of L&D professionals consider their virtual training experiences ineffective (Ken Blanchard Companies, 2021). The effectiveness of instructional videos largely depends on their ability to maintain viewers' attention. The findings of this study support in-company knowledge exchange in improving instructional videos by exploring the factors affecting viewers' (dis)engagement, based on the literature and the results of a study using multimodal measurements.

2 Background

2.1 Instructional videos

2.1.1 Factors influencing the effectiveness of instructional videos

The cognitive theory of multimedia learning (CTML; Mayer & Moreno, 1998) is the main theoretical framework applied for the design and evaluation of instructional videos (in different levels and sectors of education such as K-12, tertiary, adult and professional education). CTML is grounded in the understanding that "certain multimedia design principles lead to improved learning outcomes due to the nature of human cognitive architecture" (Fyfield et al., p. 155; 2022; Mayer, 2014). Mayer's list of 15 principles for efficient multimedia design was identified based on the examination of various forms of multimedia learning, including but not restricted to videos. A recent review of empirical

studies (Fyfield et al., 2022) therefore aimed to reveal which design principles have been confirmed to be effective by empirical studies, solely in the context of educational videos. The review defined effectiveness in terms of learners' ability to recall and/or apply to new contexts the content presented in the video. The principles proven as most effective in the case of video presentations are the following: *coherence* (reducing the content to the essential information), *integrating learning activities*, *embodiment*, and *shortening/segmenting* videos (see Table 1).

Table 1 - Instructional video design principles and their effectiveness, established by empirical studies (Own edited, based on Fyfield et al., 2022)

Effective Principles with the strongest support by empirical studies	**Principles with confounding findings** (e. g., they improve learning only in certain contexts)	**Principles underrepresented in research**	
Coherence: Including just the essential information **Integrating learning activities**: Make students complete learning activities in addition to watching the video **Embodiment**: include human movement or gestures **Learner control:** Students should be given control over pause, playback, or play forward. **Video length reduction**	**Modality** (refuted by most studies): Use spoken narration rather than written text **Redundancy** (refuted by most studies): Written text should not be added when narration is present. **Presenter's face**: Avoid including the presenter's face when alternative visuals are displayed. **Signalling**: Important information should be highlighted to learners. **Personalisation**: Narrations should use first/second person conversational speech **Transience**: Video loses advantages over static media when too much information is presented too quickly.	<u>Principles considered effective but examined by few studies</u> **Reviews** (3): Videos should end with a summary of the content. **Pre-training** (2): Using words and pictures rather than words alone. **Multimedia** (2): Using words and pictures rather than words alone. **Misconceptions** (2): Conceptual videos dispel common misconceptions at the start. **Spatial contiguity** (3) Related elements presented in close physical proximity on the screen (also called split attention). **Perspective** (1): Videos shot from the learner's perspective are more effective than the third-person perspective. **Dialogue** (2) **Interactivity** (4) <u>Principles with confounding findings</u> **Guided discovery** (1): hints and feedback as the learner solves problems. **Emotional design** (4): Warm, high-	<u>Principles examined by no empirical research for instructional videos</u> **Voice principle:** Human superior to machine voice. **Drawing**: Asking students to create drawings while reading the text **Temporal contiguity:** Related elements (e.g., narration and visuals) presented at the same time.

Segmenting: Longer videos should be broken into meaningful chunks.	**Worked examples**: Include completed guidance or examples when solving problems or learning skills.	saturation colours and anthropomorphisms used in videos. **Sound effects** (1): to be avoided due to their distracting effect. **Background music** (3): to be avoided due to its distracting effect. **Speech rate** (2) (fast superior) **Audio quality** (2)	

2.1.2 Videos applied in workplace learning

Most studies exploring the key factors for the effectiveness of instructional videos focus on higher education while very few studies have been carried out on the topic in the context of organisational learning. These studies aim to highlight the benefits of instructional videos in organizational knowledge exchange: They effectively support onboarding, increase the flexibility of the pieces of training, allow participants to progress at their own pace, they facilitate learning for diverse groups (Nederveld & Berge, 2015), and significantly contribute to the development of psychomotor skills (Wong et al., 2019). As regards the challenges of the application of videos for workplace learning, they received less attention. An experimental study investigating the effectiveness of videos applied for organizational learning (Okano et al., 2018) drew attention to the effectiveness of two incentives, both of which can increase the long-term retention of the content of the videos. The group of employees a) who took part in a structured discussion led by an instructor right after the video and b) who had to answer questions interpolated throughout the whole video, remembered the content substantially more (25~26% respectively) the next day, compared to those who just watched the video or discussed it spontaneously, among themselves. This result is consistent with the principle of "integrating learning activities", emphasized by Fyfield and his colleagues (2022, see Section 2.1.1.), based on numerous empirical studies.

2.2 Emotions influencing learning engagement

In the context of organizational learning, individuals play a crucial role in knowledge construction: they create meaning, share knowledge and apply it; thus, „effective KM strategy lies in the efficient management of individuals as knowledge resources" (Ragab & Arisha, 2018, p. 212). L&D programmes are keys to developing employee knowledge (Ragab & Arisha, 2018) but efficiency is closely linked with emotions that play a significant role in cognitive processes

such as attention, learning, and memory (Altuwairqi et al., 2018; Tyng et al., 2017). Theories on emotions influencing effective learning have been widely studied in education science in the past two decades (Fredricks et al., 2016; Reschly et al., 2020) and its findings highlighted relevant connections for other disciplines as well (Noe et al., 2010).

2.2.1 Role and effect of boredom

The control-value theory (Pekrun, 2006) argues that while some emotions activate, others hinder learning and engagement. One such emotional state, *boredom*, has been receiving attention in recent years, both in education science and organization science. A recent research review (Yadegaridehkordi et al., 2019), analysed the empirical studies carried out with the help of digital applications for emotion recognition (affective computing). The comparison of the studies shows that in the past 2 decades, a wide range of emotions has been examined with the tools of affective computing. Of all these emotional states, "boredom" has been the one for which most studies have sought answers. Boredom is characterised by reduced attention and task involvement which harms goal attainment while it can also motivate the search for alternative goals and opportunities (Bench & Lench, 2013).

Most studies agree on the deactivating effects and unpleasantness of boredom (Pekrun, 2006; Sharp et al., 2020); the definition and measurement of boredom however raise questions that have so far been answered in controversial ways. One of the most significant reviews (Goetz & Hall, 2014) identifies 5 types of boredom (indifferent, apathetic, calibrated, searching, and reactant), by the dimensions of valence (degree of pleasantness) and arousal (physiological activation). This concept has been challenged by some others (Danckert et al., 2018; Elpidorou, 2021) arguing that boredom is a ubiquitous state that can be defined by the perceived meaninglessness and the level of attention. The current study aims to contribute to this debate by providing new measurement results.

Contrary to boredom, interest is an "intrinsically valuable […] engagement with an activity, object, or content" (Pekrun, 2019, p. 909). Emotional interest engages learners with an emotional connection to the content. Cognitive interest is raised by clear and easy-to-understand content (Mazer, 2017:352; Pekrun, 2019). Though boredom is more than a lack of interest, based on the above linkages, the current study examined the changes of interest, to track changes in boredom (Pekrun et al., 2014).

2.2.2 Coping with boredom as a learner

Section 2.1.1 discusses some strategies that can be applied by the professionals designing instructional videos, to prevent or reduce learners' boredom. Learners nevertheless have responsibility for the management of their own emotions hindering their learning. Numerous studies examine the most effective strategies applied to successfully cope with workplace boredom. Task-related imagination, refocusing attention on task, changing task complexity, increasing task engagement ad gamification are some of these strategies (Cummings et al., 2016; Nett et al., 2010). What they all have in common is that the first step is the recognition of a state of boredom; if this recognition is done, and if it is accompanied by the right strategy, the experience of boredom contributes to more effective learning.

2.3 Measuring boredom

Methods applied within the current study relied on the findings of 3 methodology reviews of engagement detection (Dewan et al., 2019; D'Mello et al., 2017; Dubbaka & Gopalan, 2020; Yadegaridehkordi et al., 2019). Depending on the level of user intervention, data collection can be automatic, semi-automatic or manual (Dewan et al., 2018; D'Mello et al., 2017). By their channel, data can be textual, visual, vocal, physiological, or multimodal. Since in the context of learning, each method may include biasing factors, several studies (Mazer & Graham, 2019; Yadegaridehkordi et al., 2019) recommend a multimodal approach, e.g., incorporating data from different channels and relying on both human-assisted and automated detection (D'Mello & Kory, 2012). One of the reviews (D'Mello et al., 2017) recommends the strategy below (see Figure 1), to identify the causes of disengagement.

A first step can be to measure some selected emotions hindering student engagement. Next, it should be explored, what kind of events preceded their appearance. This can lead to the modelling of the possible triggers or antecedents of the given emotion.

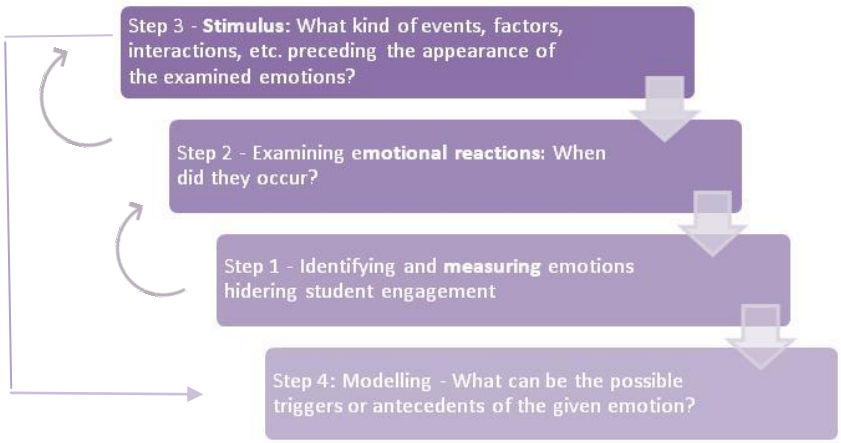

Figure 1: Building a re-engagement strategy by exploring the reasons behind disengagement (Own edited, based on D'Mello et al., 2017, pp.118)

A systematic literature review on boredom during learning (N=57) conducted by the authors revealed that though features of instructional videos and emotion detection during learning are widely studied, to the best of our knowledge, no empirical studies investigated the relationship between automatically detected emotions and the elements of the videos triggering them, as suggested by the above strategy.

3 Methodology

The current study applied multimodal measurements interpreted as an approach relying on both language-based and nonverbal communication (Christensen et al., 2018; Jewitt, 2014; Poria, 2016). The sample (N=25) included university students (aged 19 to 23) of Corvinus University of Budapest. Observations were implemented in individual meetings (in October 2023). The participants of the observation pursued their studies in the Communication Science BA programme, and at the time of the observation, they were enrolled in the same course, the instructor of which produced the instructional video covering a topic (virtual communication) closely related to their current curriculum. Their emotions were detected by self-report questionnaire, automated facial expression analysis during video watching, and retrospective interviews to triangulate the validity of facial analysis results. Before and after watching the video, a questionnaire assessing participants' emotional state was completed (Positive-negative Affectivity Scale, PANAS, Watson et al., 1988), to

follow current emotional state bias; the questionnaire also included the questions of Student Interest Scale (Mazer, 2013).

Numerical results of the questionnaires and of automated facial expression detection were analysed by correlation analysis and linear regression, using SPSS, Noldus FaceReader and The Observer XT. Interviews were examined by qualitative content analysis, using the constant comparative method. The 22.4-minute-long recordings (per participant) were divided into 30-second long time windows. Mean values were calculated for boredom, interest, arousal and valence for these intervals, and were compared with the characteristics of the instructional video.

4 Results and implications

4.1 Emotional states identified by facial expression analysis and self-reported emotions

Changes in the mean value of boredom and interest confirmed the asynchronous relationship between them, namely that boredom is not a lack of interest but a state influenced by other components as well, such as the low level of arousal and high level of "neutral" state (Goetz & Hall, 2014; Grafsgaard, n.d.; Kapoor et al., 2001): low interest was not always associated with high boredom and vice versa (see Figure 2).

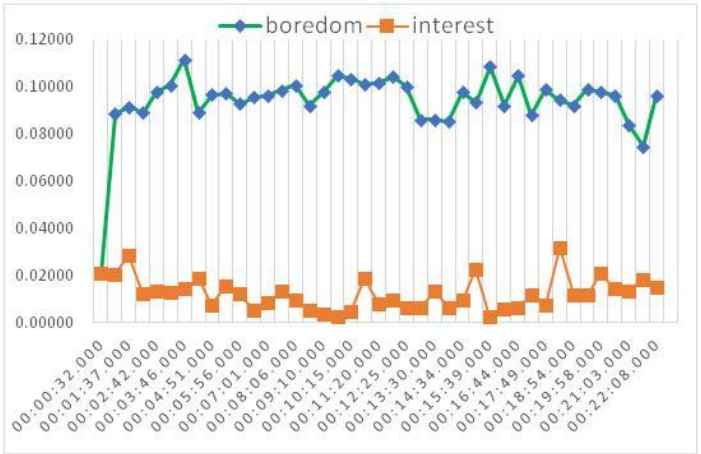

Figure 2: Changes in the mean values of boredom and interest per 30 seconds while viewing a 22-minute long video presentation (N=25), measured by facial expression analysis, in 30-second long periods.

For the synchronous and asynchronous development of boredom and interest, we examined the identifiable variables (video/presentation features, visual/topic elements, teacher behaviours, video design principles, etc.) associated with congruent (e.g., high boredom low interest - synchronous) and incongruent (both high/low) situations. The reasons behind incongruent results require further investigation, but congruent data allow clear conclusions on video-based learning contents (see Table 2).

Table 2 – Features of video followed by episodes of viewer boredom and interest

Antecedents of low level of boredom & high level of interest	**Antecedents of high level of boredom & low level of interest**
1. appearance of the presenter's face 2. short illustrating story with a portrait photo 3. slide with graph supplemented by teacher's freehand drawing 4. funny, witty closure	1. slides with black text on white background 2. graphs with longer or small-print explanation 3. flow chart with multiple abbreviations unknown to the viewer 4. slide with a table displayed for 8 minutes with teacher's explanation 5. the language of the oral explanation differs from that of the explanation on the slide

Level of boredom and interest was identified as high in the case of values exceeding mean values plus half of standard deviation.

Linear regression examining the relationship between (auto-detected) emotions during and (self-reported) emotions after video viewing revealed that self-reported interest predicted positive affectivity after video watching (R^2=0.525, $p<0.000$). This confirms that positive emotional state scaffolds attention and interest in learning (Mazer, 2013).

A significant negative correlation of surprise during video watching and self-report cognitive interest ($R=-0.502$ $p<0.001$) suggests that surprising elements should be used with caution, to avoid stress resulting from overly diverse stimuli.

4.2 Factors and tools influencing engagement according to the student interviews

In the semi-structured student interviews following the video watching, the first set of questions aimed to identify the factors that made the video attractive to them and the episodes that were difficult for them to follow. Next, we asked specifically about the teaching/lecturing methods used in the video (e.g., slide with text, graph, table, picture, teacher's face, story), asking which of these methods helped or hindered them the most in maintaining their attention. The results were consistent with the results of the facial analysis presented in Table 2 but also revealed additional factors, of which visual elements and examples were particularly frequently mentioned (see Table 3). Almost each student mentioned that the appearance of the teacher face increased their attention and interest. As some of them mentioned it, this positive effect is closely linked to the fact that learners like the lecturer. Student answers were analysed by constant comparative method (Glaser & Strauss, 1967). The following table (Table 3) includes the main and sub-categories set during the coding.

Table 3 - Factors increasing engagement, based on learner interviews

"What did you like in the video?"	**Number of participants mentioning it**
visual elements promoting understanding - table (11) - important information highlighted by on-screen annotations (12) - graphs presenting statistical data, pictures (18)	44
examples presented to illustrate concepts - stories (13) - examples (11)	24
humour; surprising, witty start and closure - humour (11) - surprising start (2) - witty, funny closure (7)	20
"the topic is interesting" - content relevant to learners and adapted to their level of knowledge	21
the appearance of the teacher's face	15
teacher's immediacy, the student's attachment to the teacher	8
casual, conversational language that is close to the target audience	4
smooth, dynamic presentation, using various tools	4

According to the interview answers, the elements mentioned the most frequently considered as attractive were linked with visual information: various graphs, figures and pictures illustrating or presenting the information increased student attention. The second group of factors mentioned by the students referred to the application of examples (shorter or longer case studies, stories, or just references to certain enterprises or brands). The immediacy, personality and warmth of the communication of the instructor were mentioned by the majority of the participants.

The elements *hindering attention* were almost entirely related to the *texts displayed on the slides*: a slide displayed for too long time (mentioned by 14 of the participants), redundancy ("it is too difficult to read the slide and listen to the instructor at the same time") (15), mind wandering, and difficulty in understanding and following the line of thought when the video showed slides with text (16).

4.3 Video design principles

According to the authors' coding, the video used for the current study followed 8 of the principles of instructional video design defined by the review (Fyfield et al., 2022) presented in Section 2.1.1. These were: embodiment, presenter's face, signalling, personalisation, worked examples, multimedia, spatial contiguity, temporal contiguity. Learner answers were also coded according to these principles as well. Since in this case, we wanted to know what principles they consider important for educational videos in general, we categorised the content of their responses irrespective of whether they were reflected in their positive or negative comments (like in the case of modality and redundancy).

Table 4 – Appearance of the principles of instructional video design (Fyfield et al., 2022) in the video applied in the study

Instructional video principles mentioned in the learner interviews	Number of mentions in student answers
multimedia (graphs, figures, colours)	34
redundancy (information is presented both spoken and written) – not applied, mentioned as a challenge	29
personalization (teacher style, immediacy and positive attitude)	27
worked examples (stories, company names, facts)	24
modality (too much text on the slides) – not applied, mentioned as a challenge	23
coherence – where not applied, mentioned as a challenge	18

embodiment (appearance of the teacher's face)	15
signalling (important information highlighted by on-screen annotations	12

5 Conclusions

The study offers some important insights into the factors promoting learning engagement or triggering boredom. Some factors nevertheless indicate that the findings of the study need to be interpreted cautiously: the sample included the video of one instructor. Student interviews revealed a high level of student attachment and trust in the teacher. The topic of the video in question is furthermore very popular among the members of generation Z: „Virtual communication". In order to increase the generalisability of the results, it would therefore be necessary to examine videos produced by teachers with different teaching attitudes and used in different fields of study using similar analysis methods. Awareness that participants were being watched and their expressions were being recorded has led to an observation bias, thus the emotional state of boredom might be lower during the observations than in the course of the usual online learning activity of the students.

The results confirm the relevance of several video design principles such as multimedia, personalization, embodiment and signalling were successfully considered and reflected by the learners. The difficulties reported by them related to the role and amount of textual information provided parallelly with the audio content. The reasons behind these challenges and the solutions are summarized by the principles of coherence, modality and redundancy: learners' cognitive workload can be decreased by presenting only the essential information, providing spoken narration, rather than written text, and avoiding presenting rich textual information during narration.

Aknowledgement

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Enhancement of Cultural Heritage Tourism along the Darb Zubaydah Pilgrimage Route in Saudi Arabia: Fayd Oasis as a Sustainable Development Scenario

Monica Moscatelli

SA Lab, Architecture Department
College of Architecture and Design
Prince Sultan University
P.O.Box No. 66833 Rafha Street, Riyadh 11586 Saudi Arabia

Abstract

Saudi Arabia opened its doors to tourists in September 2019 and unveiled ambitious tourism plans during its G20 presidency in April 2020. The cultural heritage is remarkable, given the rich history of Saudi Arabia. With the Saudi Vision 2030 built around three themes "a vibrant society, a thriving economy, and an ambitious nation," tourism figures prominently as one of the primary sources of diversification of the Kingdom. This strategic framework aims to enrich the journeys of Makkah-bound pilgrims while in the Kingdom and establish tourist and historical sites and cultural venues to enhance the pilgrimage experience. The paper concerns one of the five pillars of Islam: the annual Islamic pilgrimage (Hajj) to the Holy City of Makkah, considered one of the most important and ancient in the world. The pilgrimage routes were religious and commercial axes that crossed the Arabian desert, favouring movement throughout the ancient world and creating a "heritage route." The research study focuses on Darb Zubaydah, the main historic Hajj pilgrimage route connecting Kufa in Iraq to Makkah in Saudi Arabia. This 1,300 km route has 13 heritage sites, four in Iraq and nine in Saudi Arabia. The Dar Zubaydah is a historical, cultural route of exceptional universal value, and since 2 January 2022, it has been included in the Saudi Heritage Tentative List of UNESCO. The research aims to promote and bring to light the cultural heritage along Darb Zubaydah by developing sustainable cultural tourism. The paper defines guidelines enhancing services near the historical sites and between one pilgrim station and another to reduce distances. Fayd Oasis, one of the most important and strategically located stations in Darb Zubaydah, has been selected as a case study for a sustainable development scenario to revitalize today's archaeological site and implement its services. The goal is to strengthen the pilgrimage route's cultural identity and historical heritage through services for tourists and pilgrims that promote Saudi cultural heritage while preserving the environment and natural resources. Defining a strategic plan to enhance this tourist axis of pilgrims is essential to promote the cultural landscape and heritage by strengthening the sense of identity towards a sustainable approach. The result of this study wants to contribute to Vision 2030

to enhance the development of tourism through the revitalization of the Islamic, Arab, and national cultural heritage of the Kingdom. It can be applied in other Hajj pilgrimage routes and on a global scale.

Keywords – Cultural tourism, Heritage, Pilgrimage route, Saudi Arabia, Sustainability.

Paper type – Academic Research Paper

1 Introduction

Saudi Arabia is experiencing rapid growth in hospitality and tourism due to its efforts to diversify the economy away from oil. Saudi Arabia's development into the tourism sector is part of the ambitious "Vision 2030" plan, aiming to diversify the country's economy and strengthen the Islamic identity through strategic national tourism. The National Tourism Strategy plans to increase the tourism sector's contribution to domestic product to over 10%, provide one million more job opportunities and attract 100 million annual visits by 2030 (Ministry of Tourism).

As the birthplace of Islam, many pilgrims and traders have crossed the Kingdom over the centuries to reach the Two Holy Mosques and Holy Places. In recent years, pilgrims and tourists entering the country have tripled to 8 million people. The government has launched numerous initiatives to promote urban planning processes and programs to improve tourist offers (Mazzetto, 2022). One is the Pilgrim Experience Program, launched in 2019, to support pilgrims' journey to Mecca (Makkah). The program includes implementing services, transport, and facilities to improve their hospitality. Also, the next step is to prepare historical Islamic sites to enrich their religious and cultural experience (Vision 2030).

The research highlighted in this paper wishes to be part of the Pilgrim Experience Program, aligning itself with one of the five pillars of Islam, namely the annual Islamic pilgrimage (Hajj) directed towards the Holy City of Makkah. Since Saudi Arabia is rich in Arab and Islamic historical and cultural heritage, the goal is to build a future based on the creation of a system of public services for religious and cultural tourists directed to the Holy City by creating a "heritage route," for build profitable tourism growth through sustainable strategies, but at the same time preserving national identity by considering economic, social and cultural values (Moscatelli, 2022). The transit of pilgrims is essential for the identity of the heritage and the management of a successful modern pilgrimage, as well as

ensuring the Kingdom's economic growth. The research expands the pilgrim's routes and landscape knowledge by examining sustainability and global challenges. Furthermore, it will highlight natural and cultural heritage by developing jobs and growth along pilgrim routes through developing a low-impact tourism itinerary and strengthening local traditions; this reconnects pilgrims and visitors with their environment, landscape, and culture.

2 The Ancient Pilgrimage Routes to Makkah: a link between Islamic cities and Saudi Arabia

Saudi Arabia has historically been a centre for travellers, pilgrims, and merchants, as it is home to two of Islam's holiest cities, Makkah and Medina. For centuries, millions of pilgrims have made long-distance journeys to reach the city of Makkah, which has a unique character and image as a sacred land for Muslims worldwide. Every year, during the Hajj, the number of Muslims who go to the Holy City increases more due to the ease of land and air transport. The statistical data analysis (GASTAT, 2019) showed that 94% of foreign pilgrims in 2019 mostly used the air route. Only 5% arrived by land, and 1% by sea (Fig. 1). These new facilitated transport ways have made the historical pilgrimage routes obsolete, and some overlap with the new roads and highways. The roads leading to Makkah have always been vital to the religious and economic life of Arabia, extending as far as Syria, Egypt, and neighbouring countries. Given the importance of these pilgrimage routes, they require particular attention and implementation by creating cultural and sustainable itineraries.

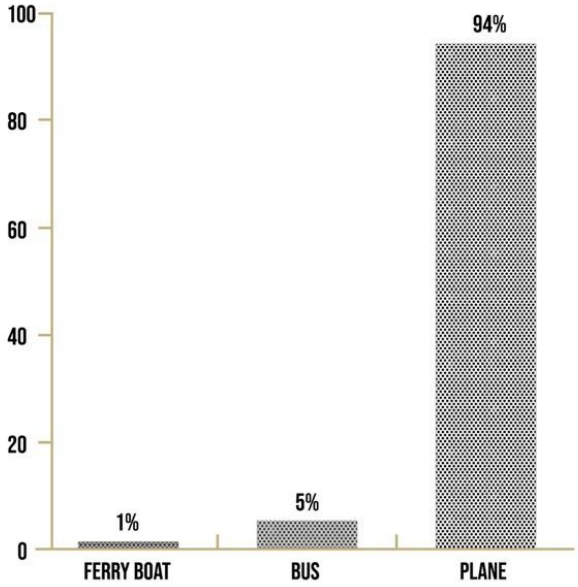

Figure 1. Foreign pilgrims in 2019 by transportation mean (Credit: Author)

2.1 The four main Routes of Hajj

The ancient land routes of the Hajj, from neighbouring countries to Saudi Arabia, materialized over time due to trade routes and cultural exchanges. Moreover, these deeply rooted cultural and religious traditions have constituted the most crucial material traces of Islamic civilization over the centuries.

In the past, the journey to Makkah was arduous; the pilgrims had to travel for months on caravans, horses and donkeys and cross the desert on dirt paths with extreme temperatures and avoid possible raids and other obstacles along the way. Some service stations with water wells along the routes allowed for stops during the long journey. Several primary and secondary routes lead to Makkah, but four are the most important ones (Fig. 2).



Figure 2. The most important ancient land routes of Hajj (Credit: Author)

1. The Pilgrim Road from Syria: it connected Damascus to Makkah, passing through the province of Tabuk in Saudi Arabia, and Madain Saleh (Hegra), an archaeological site in the Al-Ula area, today an important tourist destination of the Kingdom rich in cultural heritage. This route is referred to as the Ottoman or Shami (Levant) route.
2. The Pilgrim Road from Egypt: the African road used by pilgrims from Egypt, Morocco, Andalusia, Sicily and various areas of Africa. Along this route are rock carvings by pilgrims as a reminder of their Hajj journey.
3. The Pilgrim Road from Yemen: came from southern Saudi Arabia. There were three routes, one coastal, one internal and one primary, crossing the province of Asir in Arab territory until the city of Taif and then Makkah. Along the way, there were several villages where pilgrims stopped.
4. The Pilgrim Road from Iraq: connected the city of Baghdad and Kufa in Iraq to Makkah, traversing the north of the Kingdom and its centre, passing the vast and treacherous sands of the Empty Quarter, the

largest sand desert in the world, before reaching the Holy City. This ancient route is known by the name Darb Zubaydah because it takes its name from Zubaydah bint Jafar, wife of the Abbasid caliph Harun Al-Rashid, for the remarkable charitable work she has supported along the Hajj route through the construction of numerous stations, canals, wells, forts and mosques.

3 A strategic itinerary for a sustainable cultural tourism

The research aims to promote and bring to light the cultural heritage along the Iraqi route, Darb Zubaydah, by developing sustainable cultural tourism.

Through a qualitative analysis of the nine sites identified by UNESCO, documentary research and field evaluations, the research method was divided into three phases (Fig. 3).

The first phase of the work involved collecting information on some important architectural landmarks and the nine archaeological sites along the Saudi route. This step considered a literature review of Darb Zubaydah and was supported by analysing cartographic, iconographic and bibliographic materials. This qualitative research identified the nine sites exploring the aspects concerning the urban history and the most important architectural resources of the landscape along the route.

A second phase of the work involved site visits along the route to detect existing conditions of the physical context: the accessibility of Darb Zubaydah, the main facilities and the archaeological sites. The field evaluation was crucial to identify the potential site to promote its cultural landscape and heritage, revitalize the area and promote services and activities for tourists and pilgrims.

A later step defines a strategic proposal to enhance this tourist axis of pilgrims, enhancing services in the sites and between one station and another to reduce distances. The research was later focused on Fayd Oasis, located halfway between Kufa and Makah. It was placed in the most strategic position of the route to develop a sustainable development scenario to revitalize today's archaeological site and implement its services.

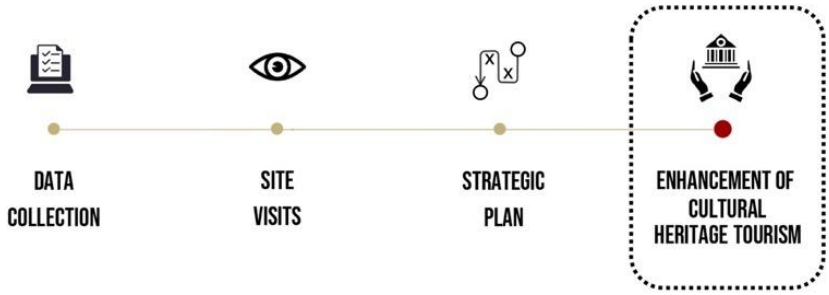

Figure 3. Research methodology (Credit: Author)

3.1 Phase 1. Data collection

The research focuses on the Darb Zubaydah, which hosts a cultural heritage rich in unique examples of architecture and infrastructural planning that should be preserved and valued. Due to the importance of these architectural artefacts, the Darb Zubaydah pilgrimage route was inscribed on UNESCO's World Heritage Tentative List on 2 January 2022.

The cultural heritage and the different architectural typologies that can be encountered along the way are the results of the flow of pilgrims and traders along the Darb Zubaydah. The route includes 27 stations and 27 substations, and key elements from the Abbasid period, which materialize the 1.300 km long path linking the city of Kufa in Iraq with Makkah. The segment of Darb Zubaydah in present-day Iraq covers approximately 1/5 of the trail's total length; instead, the other part in Saudi Arabia covers 4/5. The entire route counts 13 sites, four in Iraq and nine in Saudi Arabia (Fig. 4), providing an architectural overview of this extraordinary Hajj route (UNESCO, 2022). They have been selected for their state of conservation, representativeness, and geographical position along the route.



Figure 4. Main stations and heritage sites of Darb Zubaydah route (Credit: Author)

The route was indicated by "route markers" and milestones, shelters and water systems for the benefit of pilgrims. This road has seen extensive historical and archaeological research, whether on the development of stations along the route, water structures, or milestones (Gierlichs, 2012).

A series of consecutive settlements bounded the road. Among the selected heritage sites, wells were identified in each settlement to provide adequate water for many travellers and their animals, given the heat and aridity of the region. The provision of water facilities is one of the best-studied elements of the Darb Zubayda, and the presence of mosques is another essential requirement for pilgrims (Blair and Ulrich, 2013).

3.2 Phase 2. Site visits

The second step of the research methodology involved site visits along the route to capture the criticality and potentiality of the road and its facilities. The author carried out the inspection personally through direct observation on-site.

During the tour, the critical points of the pilgrimage road were identified as listed below.

- Lack of access to Darb Zubaydah through secondary roads.
- Far distance between the identified heritage sites and pilgrim stations.
- Lack of roadside services.
- Lack of accommodation to host a good number of tourists.
- Scarcity of religious places between one city and another.
- Lack of night lighting along the route.
- Lack of archaeological sites promotion to tourism.
- Shortage of protection of archaeological sites.
- Lack of information and explanation of archaeological sites.

3.2.1 The archaeological site of Fayd

Then, the attention has focused on the city of Fayd, considered the major oasis city along the pilgrimage road from Baghdad. It is the most prominent landmark in the city of "Fayd" and the largest palace on the Hajj route (Fig. 5). The author considers it a case study station to implement the services around the site by promoting its heritage and cultural landscape. The researcher conducted site visits and photographic surveys of the archaeological area to verify the current state of the site and its related services.



Figure 5. Fayd archaeological site: satellite photo of the area (Credit: Bing Maps)

The city of Fayd is the most significant archaeological and historical site located 120 kilometres southeast of Hail and 1.5 km north of the present modern town of Fayd. It is the oldest settlement in the Arabian Peninsula, 1300 years ago, and covers an area approximately 1.5 km long by 1.5 km wide (Ibrahim et al., 2021). The oasis of Fayd, in the early period of the Abbasid Caliphate and even before

the Islamic era, was considered the most important and strategically located along the Darb Zubaydah route. Furthermore, it was the main station for pilgrims, as it was used to supply food and water. Pilgrims and merchants converged on this oasis for more than five centuries.

There are records dating back to the 13th century, where Fayd is described as a fortified city with double walls of black basalt, a large fortress consisting of several floors with a tower in each corner, a mosque dating back to the early Islamic era, and wells for the water supply (UNESCO, 2022). To date, the ruins of the Kharash Palace, the old houses, the mill for grinding cereals, and the wells are visible. The fort's walls have recently been rebuilt to give an idea of what the site was like. To the south of the fort, between the two walls, excavations have brought to light a series of rooms belonging to the homes and perhaps to the shops of the people of the Fayd oasis (Fig. 6) built around a central road (Fig. 7). Furthermore, an area with ovens used by the population was found to the south. The remains of the ancient mosque used by the inhabitants of Fayd and the pilgrims and merchants who visited it are also visible. The primary water sources were two large water cisterns, still visible today: a tank located north of the village and one to the southeast (Egal, 2017).



Figure 6. Fayd fortress: residential rooms and commercial spaces (Credit: Author)



Figure 7. Fayd fortress: ruins of the houses built along a central road (Credit: Author)

As for services, before entering the archaeological site, visitors go through the Fayd Museum, which contains the finds of the ancient fortress and its surroundings. There are no outstanding services around. A petrol station with a mosque without architectural value is visible on the other side of the road.

Therefore, it is necessary to identify a strategy to implement the services, activities, and various hospitality options around the sites of most significant interest to bring greater tourism to these areas of particular cultural landscape and heritage interest.

3.3 Phase 3. Strategic plan

The paper defines a strategic plan to implement tourism along the Darb Zubaydah pilgrimage route and enhance the nine heritage sites and monuments to highlight and strengthen the cultural identity of these places. The strategy adopted involved a first phase which dealt with finding guidelines for large-scale planning relating to the accessibility and implementation of the activities to be established along the pilgrimage route. Later, the next step focused on enhancing the archaeological site of Fayd, defining guiding principles for creating public and reception spaces with equipped service infrastructures. The aim is to make the Darb Zubaydah an economic engine and a first-rate cultural itinerary, offering boundless artistic and natural riches.

3.3.1 Planning strategy to enhance cultural heritage tourism along the Darb Zubaydah

It is necessary to review the stages, itineraries, kilometres and routes between stations that are part of the Darb Zubaydah to promote tourism along the pilgrimage route. In this way, it is possible to establish secondary roads perpendicular to the main axis to make the pilgrimage route more accessible at different points along the road to allow tourists and pilgrims to choose the most suitable itinerary for them, from the longest one to the shortest one which can concern only a few stages. The strategy is to have stages of different distances, such as short stages of 10 km or longer ones of 30 km. The kilometres can increase or decrease if the visitors choose to travel one or more of the variants of the route. The different itineraries can be covered on foot, on the camel, by bicycle, or through sustainable electric means to reach the stages faster and with less effort, in a few days or several months, especially during the winter and spring seasons, depending on the stages the tourist want to tackle and the amount of km to go. Road signs will therefore be implemented indicating the various itineraries, the km and the time to travel them depending on the modes of transport used. Furthermore, every tourist can download an app with GPS coordinates onto their phone to help them find their way on their smartphone, consulting the different possible itineraries and cultural events for each station. Smart technology will therefore be part of this strategic plan. The lighting along the road and in the archaeological sites will be implemented to be able to visit the archaeological sites at night and have a different perception of the site between day and night. The stations will become landmarks along the route, a reference point for pilgrims and tourists.

Refreshment services, collective and commercial spaces, health centres, and lodgings for pilgrims will be strengthened along the way. The tented camps, reminiscent of Bedouin tents, will host tourists in an authentic space to get closer to the local traditional culture and the desert landscape. The current petrol stations will be implemented with receptive structures, exhibitions and prayer spaces. A widespread museum could be distributed along the route as a tool for cultural infrastructure (Raffa, 2017). Particular emphasis will be given to the architectural space of the mosques, which must not be seen as a simple room, but as a socio-cultural architectural space that strengthens religious identity.

Particular focus will be given to archaeological sites that will be preserved and enhanced by implementing different activities.

The path along the Darb Zubaydah is not only meant to rediscover one's spirituality and religiosity but also a way to find oneself, a journey to be travelled alone or in a group. It is an alternative to mass tourism in the name of physical and spiritual well-being and, above all, a journey rich in history and culture to discover the rich cultural heritage of Saudi Arabia. The idea is to promote sustainable, healthier and more affordable tourism in contact with the nature of the pristine desert, crossing places of extraordinary historical and monumental beauty.

3.3.2 Fayd Oasis as a sustainable development scenario

Fayd Oasis has been selected as a case study as a sustainable development scenario (Fig. 8) to revitalize today's archaeological site and implement its facilities to transform this ancient site into a tourist attraction. The oasis of Fayd, located midway, will be considered, as in the past, the main pilgrimage station along the entire route. Therefore, a greater flow of people is expected, and consequently, more services and activities need to be implemented near the archaeological site.

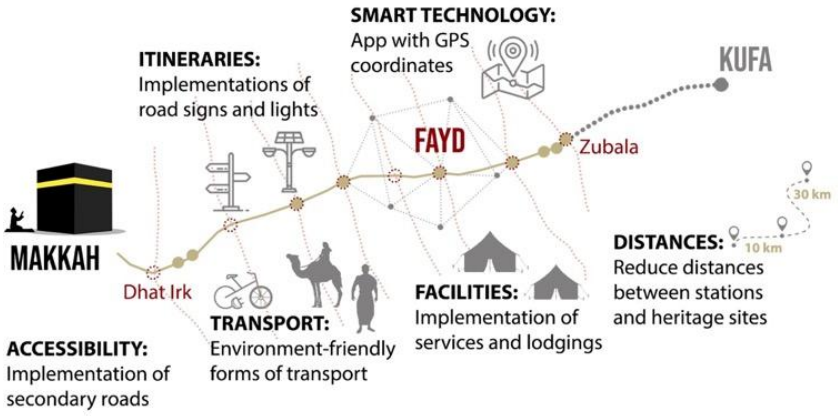

Figure 8. Enhancement of cultural heritage tourism along the Darb Zubaydah

Fayd will have to become a cultural and receptive space with various entertainment activities for pilgrims and tourists. In addition to the existing museum, other services will be added, such as additional exhibition spaces,

mosques, refreshment places, a primary healthcare centre, commercial areas, and places to rent bicycles, electric vehicles, or the traditional camel to enjoy the Bedouin experience.

The archaeological site will be preserved and enhanced by promoting tourist itineraries during the day or night to discover the fascinating history of the Fayd fortress. Qualified guides will lead tourists through the ruins of the archaeological site and the Kharash Palace. Cultural and scientific forums, exhibitions and events in the oasis of Fayd will entertain the tourists during their stopover halfway between Kufa and Makkah.

4 Conclusions

The proposed strategy wishes to enhance cultural heritage and identity in landscapes so that they are integrated into assessments of ecosystem services to inform policy-making and physical and spatial planning for the sustainable management of ecosystems and cultural landscapes. The strategic approach shows how to value natural and cultural heritage while developing jobs and growth along the pilgrimage route by developing low-impact tourism, digitalisation, accommodation of tourists and strengthening local traditions to reconnect tourists and pilgrims with their environment, landscape and cultural heritage.

This research contributes to Vision 2030 to enhance the development of tourism through the revitalization of the Islamic, Arab, and national cultural heritage of Saudi Arabia. The Darb Zubaydah pilgrim route represents an integral part of that era in Muslim civilization. Unfortunately, its archaeological features are now suffering from negligence and extinction. It is undoubtedly an infrastructural axis with archaeological sites that deserves the attention and cooperation of the United Nations Educational Scientific and Cultural Organization (UNESCO), the International Council of Monuments and Sites (ICOMOS), and the World Tourism Organization (UNWTO) promoting such destinations rich in historical heritage. This sustainable strategic plan, therefore, requires an integrated approach that can be generalized and applied in other pilgrimage routes and on a global scale.

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Identifying Future Avenues of Research for Platform Ecosystems: A Topic Modeling Analysis

Pietro Vito*

Department of Management
University of Rome Sapienza
Piazzale Aldo Moro 5, 00185 Rome (Italy)

Francesca Iandolo

Department of Management
University of Rome Sapienza
Piazzale Aldo Moro 5, 00185 Rome (Italy)

* *Corresponding author*

Abstract

In this study, we employ topic modeling to systematically explore the platform ecosystem literature and identify emerging trends and potential avenues for future research. By leveraging computational techniques, we uncover hidden thematic structures and patterns in text data, providing valuable insights into the current state of research and pointing towards promising directions for future investigation. Our analysis draws from a comprehensive dataset of academic articles and conference proceedings revealing key themes and trends in the platform ecosystem discourse. We examine the evolving research landscape and synthesize the key findings into coherent topic clusters, illustrating the breadth and depth of the platform ecosystem literature. Our analysis highlights the interdisciplinary nature of the field, encompassing various research domains such as business models, governance, value co-creation, entrepreneurship, among others. Additionally, we identify significant research gaps and unexplored areas that warrant further attention from scholars and practitioners alike. Our study provides a robust framework for categorizing and organizing the platform ecosystem literature, enabling researchers to better understand the underlying connections and relationships between different research streams. This facilitates more efficient knowledge accumulation and dissemination, contributing to the ongoing development and maturation of the field.

Keywords – Platform Ecosystems, Literature Forecasting, Topic Modeling.

Paper type – Academic Research Paper

1 Introduction

Platform ecosystems have emerged as a transformative force in the global business landscape, reshaping the way organizations innovate, collaborate, and compete. These ecosystems, characterized by the interplay between various stakeholders such as platform owners, users, complementors, and third-party developers, have become a central element in modern digital economies. The rise of platform ecosystems can be attributed to the increasing digitization and interconnectedness of firms, as well as the development of cutting-edge technologies that enable seamless integration of products, services, and data. As a result, organizations are increasingly adopting platform-based business models that facilitate collaboration, co-creation, and value exchange among diverse stakeholders (Ceccagnoli et al., 2012). In a platform ecosystem, value is created not only by the platform owner but also by the participants who contribute complementary products, services, and innovations. This decentralized value creation process fosters a more dynamic and adaptable business environment, wherein organizations can rapidly respond to emerging trends, customer needs, and technological advancements. Furthermore, platform ecosystems facilitate greater access to resources and capabilities, enabling organizations to leverage the expertise, skills, and assets of a diverse set of participants. This collaborative approach to innovation and value creation helps organizations remain agile and competitive in an increasingly complex and fast-paced business landscape. As platform ecosystems continue to evolve, they are driving significant changes in the way organizations approach innovation, collaboration, and competition. Traditional competitive strategies based on individual firms' strengths and capabilities are being replaced by collaborative approaches that prioritize shared value creation and ecosystem synergies. Moreover, as platforms become increasingly central to the digital economy, organizations must develop new skills and capabilities to effectively navigate these complex and dynamic ecosystems.

From an academic point of view, as digital technologies continue to advance and integrate into every aspect of modern life, the study of platform ecosystems has become an essential area of research for scholars, practitioners, and policymakers alike. With the rapid evolution of this field, identifying future research avenues and emerging trends is crucial for staying at the forefront of knowledge and driving the development of robust and effective strategies in this domain. Topic modeling (Blei et al., 2003; Blei, 2012) offers a powerful approach

for uncovering new research opportunities and understanding the complex dynamics within the growing body of platform ecosystem literature. Topic modeling has various applications, including information retrieval, document clustering, summarization, sentiment analysis, content recommendation, and trend analysis in large text corpora. The potential of Topic modeling techniques in conducting literature reviews are illustrated in various contributions, particularly in the scientific areas of business and management (Hannigan et al., 2019; Hannigan et al., 2022) and in recent years there has been a flourishing of its applications to uncover latent topics in large sets of academic contributions (Amado et al., 2018; Chen et al., 2021; Harb and Shang, 2022).

The remainder of this paper is structured as follows: Section 2 presents the gradual broadening of the concept between the years 2001 and 2010. Section 3 details the methodology employed for the topic modeling analysis, including data collection, model implementation, and evaluation. Section 4 presents the results of our analysis while Section 5 is devoted to the labelling and interpretation of the identified topics. Section 6 offers a discussion of the results, synthesizing the findings and highlighting opportunities for interdisciplinary research and collaboration.

2 Theoretical Background (2001-2010)

In order to go beyond the Authors' subjectivity in reconstructing the development of scientific thought on the subject, according to the approaches of Tranfield et al. (2003) and Markoulli et al. (2017), the most influential references, briefly discussed below, have been identified by resorting in CitNet of Van Eck and Waltman (2014) which allows to reconstruct, in chronological terms, the networks of reciprocal citations among the contributions retrieved in Web of Science (Figure 1).

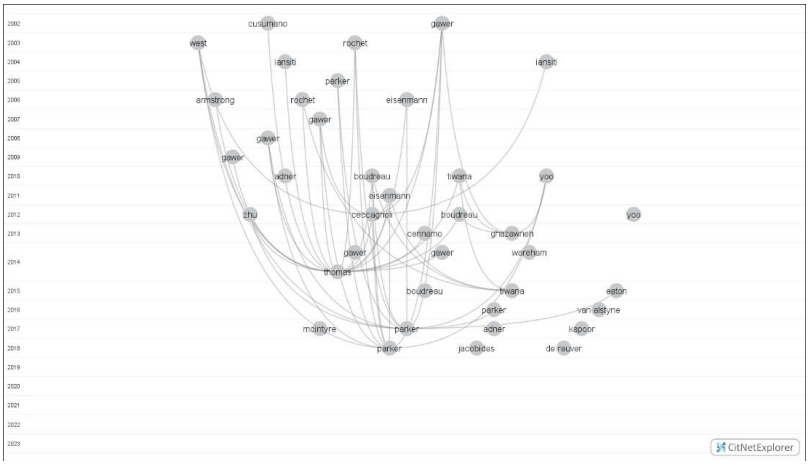

Figure 1 – Evolution of the citation network in the literature (2001-2010)

The platform ecosystem concept emerged in the early 2000s as scholars began to study the dynamics of digital platforms and their interactions with users and other stakeholders. Key contributions during this period include Gawer and Cusumano's seminal work, "Platform Leadership" (2002), that provided an early understanding of platforms as the foundation upon which complementary products and services are built. With reference to Intel, Microsoft, and Cisco, they argued that platform leaders must manage the interaction between the platform and its complementors, influencing the direction of innovation and capturing value from the ecosystem (Gawer et al., 2002). In the same period, the two-sided market characteristic of platforms was considered, to which subsequent literature would largely be dedicated (Jullien and Caillaud, 2003; Rochet and Tirole, 2003). In their seminal paper, Rochet and Tirole (2003) described platforms as intermediaries between two distinct user groups (two-sided markets) that provide each other with network benefits while Jullien and Caillaud (2003) analyze the competition among intermediation service providers in two-sided markets, addressing the "chicken and egg" problem that arises when platforms need to attract users from both sides of the market. Parallelly, West (2003) drew the attention to the balance between proprietary and open-source platform strategies, as vendors experimented with hybrid approaches to combine the advantages of open-source software while retaining control and differentiation. West's work suggested the conditions under which such hybrid strategies may be preferable to purely open or purely proprietary alternatives. This work laid the groundwork for understanding platform ecosystems as a new organizational

form. As the concept of platforms matured, researchers glimpsed the broader ecosystem that encompasses the platform and its complementors: Iansiti and Levien (2004) introduced the term "platform ecosystem" and provided a framework for analyzing the relationships and interactions within these complex systems. They emphasized the importance of network effects and the role of keystone firms in shaping the overall health of the ecosystem. The concept of platform ecosystem is further developed by Moore (2006) in his exploration of the strategic implications for firms operating in these environments. He argued that platform ecosystems require a shift in the way businesses approach strategy, focusing on creating and maintaining vibrant ecosystems that generate value for all participants. With the growing dominance of digital platforms, such as Google and Apple, researchers began to explore the implications of these new platform ecosystems. Eisenmann et al. (2006) analyzed the role of "two-sided markets" in digital platform ecosystems, emphasizing the importance of cross-side network effects for platform success. In the meantime, building upon Rochet and Tirole's findings, Armstrong (2005) presented three models of two-sided markets: monopoly platforms, competing platforms where agents join a single platform, and "competitive bottlenecks" where one group joins all platforms. Armstrong's study identified key determinants of equilibrium prices, such as the magnitude of cross-group externalities, the nature of fees, and agents' platform choices. Economides and Katsamakas (2006) further explored two-sided competition between proprietary and open-source technology platforms, such as Microsoft Windows and Linux. They developed a framework to characterize optimal two-sided pricing strategies for platform firms and compared industry structures based on proprietary and open-source platforms. Their research showed that proprietary platforms might offer lower equilibrium prices, but open-source platforms provide a larger variety of applications. In the same year, Hagiu (2006) studied pricing and commitment by two-sided platforms, considering essential bottleneck inputs, the order in which buyers and sellers arrive, and the types of fees charged. Hagiu demonstrated that monopoly platforms might prefer not to commit to buyer prices at the same time they announce seller prices if they face unfavourable seller expectations. Additionally, Hagiu found that commitment affects the likelihood of exclusive equilibria but has no impact on multi-homing equilibria when they exist. Towards the end of the decade, the literature on platform ecosystems began to coalesce around a more comprehensive theoretical understanding of the phenomenon. Baldwin and Woodard (2009) proposed a

unified framework for analyzing platform ecosystems, bringing together the various strands of literature into a coherent whole. Boudreau (2010) shifted the focus to open platform strategies and innovation, studying the different impacts of granting access to a platform versus devolving control. Using data on handheld computing systems, Boudreau found that granting greater levels of access to independent hardware developers could accelerate device development rates, while giving up control of the platform had a smaller incremental effect on development. Tiwana et al. (2010) emphasized the importance of platform evolution and the coevolution of platform architecture, governance, and environmental dynamics. They presented a framework for understanding platform-based ecosystems and identified research questions that offer significant opportunities for contributing to the information systems discipline and other reference disciplines.

3 Materials and Methods

3.1 Data

We conducted research using the Web of Science (WoS) database, a decision that brought several advantages. Web of Science is a comprehensive and curated platform encompassing a wide array of disciplines and sources such as peer-reviewed journals, conference proceedings, and books. Its curated content ensures that the materials included meet specific quality criteria. Another key benefit of searching in Web of Science is the citation analysis feature, which allows users to track the number of citations a work has received and identify who has cited it. This feature provides insights into the impact and influence of a publication or researcher. Furthermore, Web of Science offers advanced search options and filters, enabling a customized and refined search that leads to more relevant and targeted findings. To ensure a focused and pertinent search, we decided to exclude certain types of publications, such as Early Access articles, Editorial Material, Book Chapters, Corrections, and Book Reviews. By excluding Early Access articles, we concentrated on fully published and peer-reviewed research, which tends to be more reliable and complete. We also left out Editorial Material, allowing us to focus on original research rather than editorials, opinion pieces, and commentaries that may reflect the author's views rather than present new research.

Additionally, we chose not to include Book Chapters in our search. Although they can offer valuable insights, they may not be as current or thoroughly peer-reviewed as journal articles. Excluding Corrections allowed us to concentrate on the original research articles rather than minor updates or clarifications. Lastly, by omitting Book Reviews, we focused on finding primary research articles that directly contribute to the field, instead of critiques of published books.

3.2 Methodology

Topic modeling is a natural language processing (NLP) technique used to discover and extract hidden patterns or themes (topics) from a large collection of documents. Topic modeling algorithms, such as Latent Dirichlet Allocation (LDA) (Blei et al., 2003; Blei, 2012), Probabilistic Latent Semantic Analysis (pLSA) (Hofmann, 2001), and Non-negative Matrix Factorization (NMF) (Xu et al., 2003), work by analyzing the co-occurrence of words within documents and identifying groups of words that frequently appear together. These groups of words, or topics, can then be used to describe the content of the documents. For our application we first cleaned and pre-processed the text data by removing irrelevant information such as html tags, numbers, standard stop words. We also performed stemming or lemmatization to reduce words to their root forms. We also identified the set of custom stop words (e.g.: author, paper, and others) shown in the Appendix. Subsequently, we transformed the cleaned text data into: a) a document-term matrix, where each row represents a document, and each column represents a unique term (word) in the corpus. The matrix elements contain the frequency of each term in the corresponding document; b) a topic-distribution matrix, where each row represents a document, and each column represents the topic it belongs. The matrix elements contain the frequency with which each document is present in the corresponding topic. As algorithm we chose pLDA using minemytext for analysis (Debortoli et al., 2016). The algorithm outputted a set of 20 topics, each represented as a distribution over the terms in the corpus. We analyzed the topics by looking at the terms with the highest probabilities within each topic. These terms helped us characterize and provide a general understanding of the content of each topic.

4 Results

Topic modeling provides:

- a Term-Topic matrix (799x20) showing the probability with which all the examined words (in our case, 798 unique words out of 18,590 in total, excluding stop words and custom stop words) are present in each topic, allowing one to infer the content of the topic and label it.
- a Topic-Distribution matrix (345x20) showing the probability with which all the examined documents are present in each topic, in a variable percentage between 0% and 100%. From this matrix, we determine the distribution of topics over the complete collection represented in the figure which demonstrates the greater or lesser attention given to each topic in literature.

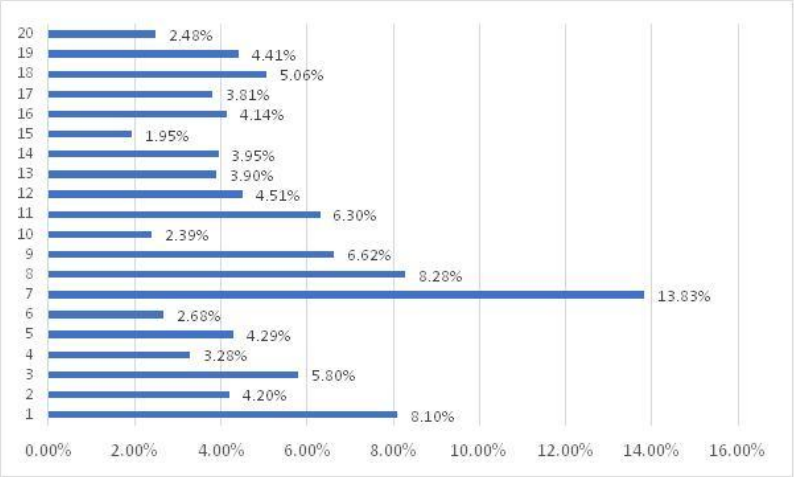

Figure 2 - Distribution of topics over the complete collection

The words characterizing each topic are listed below. Since topic modeling techniques are based on soft clustering, in which each term can belong to several topics, unlike hard clustering techniques, in which each term can belong to only one cluster, it allows to interpret the results with an understanding of the nuances and potential overlap between topics.

1. platform, ecosystem, valu, actor, activ, practic, value_cocr, framework
2. servic, platform, ecosystem, impact, environ, concept, custom, health
3. data, platform, power, market, polici, govern, infrastructur, competit

4. economi, compani, organ, platform, role, pattern, process, compet
5. firm, platform, dimens, open, produc, content, system, effect
6. platform, evolut, carbon, chang, stage, condit, event, growth
7. platform, ecosystem, strategi, market, develop, particip, case, challeng
8. innov, develop, ecosystem, platform, industri, model, relationship, theori
9. system, model, technolog, data, platform, inform, manag, tool
10. project, campaign, divers, scenario, medium, place, polici, student
11. platform, govern, aspect, theori, attent, cost, concept, work
12. business_model, industri, ecosystem, busi, network, platform, transform, innov
13. product, platform, market, firm, entri, seller, game, innov
14. knowledg, softwar, communiti, technolog, iot, develop, collabor, busi
15. control, qualiti, mode, partner, governance_mechan, access, offer, relationship
16. complementor, ecosystem, govern, platform, innov, power, resourc, softwar
17. applic, entrepreneurship, user, develop, entrepreneur, attent, import, application_develop
18. platform, app, perform, effect, develop, mechan, googl, user
19. platform, consum, market, valu, invest, model, user, manufactur
20. busi, ecosystem, enterpris, internet, mechan, process, crossborder_ecommerc, chain

5 Labelling topics

The labeling of the topics was conducted using a comprehensive, collaborative approach involving multiple stages. Initially, each author independently examined the data generated from the analysis, which included the bundle of words with their respective percentages and the 10 articles that the machine had attributed to each topic. Based on this information, each author formulated their own interpretation and suggested a potential label for the topic. Once individual assessments were completed, the authors convened in groups to discuss and compare their proposed labels. These group discussions facilitated the exchange of perspectives, as authors shared their rationale for their suggested labels and considered alternative interpretations. The aim of these discussions was to

achieve a consensus on the most appropriate label for each topic, taking into account the various viewpoints presented. In cases where conflicts arose or disagreements persisted, the authors worked collaboratively to reach a mutual agreement. This often involved further examination of the data, considering additional context, or refining the label to better capture the essence of the topic. Through this iterative process, the authors were able to develop a set of agreed-upon labels for each topic. The final list of labels, representing the collective understanding and agreement of all authors, is presented below. These labels serve as a comprehensive and accurate representation of the topics identified through the analysis, reflecting the collaborative effort and rigorous methodology employed throughout the labelling process.

1. Value Co-creation in Business-to-Business Platform Ecosystems
2. Service Platforms: Ecosystems, Impact, and Customer-Centric Approaches
3. Data, Platform Governance, and Market Power in Policy Context
4. Platform Companies: Roles, Patterns, and Processes in the Economy
5. Platform Dimensions: Openness, Content, and System in Firms' Production
6. Platform Evolution: Carbon Changes, Stages, and Environmental Events
7. Platform Ecosystem Strategies: Market Development
8. Innovation in Platform Ecosystems: Industry Models and Relationship Dynamics
9. Technology and Data Management: Models and Systems in Digital Platforms
10. Project Scenarios: Diverse Campaigns, Media, and Policy in Practice
11. Platform Governance: Theoretical Aspects, Attention, and Cost Concepts
12. Business Model Transformation: Industrial Ecosystems and Platform Networks
13. Product Strategies: Platform Market Entry, Firm Dynamics, and Seller Competition
14. Knowledge and Technology: Software Communities, IoT Development, and Collaboration
15. Control and Quality: Governance Mechanisms, Partner Modes, and Access Offerings

16. Complementor Dynamics: Ecosystem Governance, Platform Power, and Resource Management
17. Entrepreneurship in App Development: User Attention and Market Importance
18. Platform App Development: Performance Effects, Mechanisms, and Competition
19. Consumer Value in Platform Markets: Investment Models and User Perspectives
20. Business Ecosystems in Enterprise Internet: Mechanisms, Processes, and Cross-Border E-commerce

The contributions most closely related to the themes of value creation and co-creation (Topic #1) have explored various aspects of value co-creation and engagement: Hein et al. (2019) discuss the importance of collaboration and resource sharing among platform owners, complementors, and end-users to create value in B2B platform ecosystems concluding that trust, commitment, and shared goals play a crucial role in ensuring the ecosystem's longevity and effectiveness while Benz et al. (2021) provide a deeper understanding of actor engagement in value co-creation, emphasizing the dynamic nature of engagement and the need for platform owners to adapt their strategies accordingly. They argue that the degree and quality of actor engagement drive value creation in these ecosystems. Meijerink and Keegan (2019) proposed a new framework for human resource management in the gig economy, emphasizing the need to balance the interests of platform owners, workers, and clients. They argue that platform owners should focus on managing the ecosystem through governance mechanisms while workers and clients should engage in co-creating value and fostering a sense of belonging and commitment. The interplay of strategies and platform ecosystem can be found in Topic #7: in reverse chronological order Kretschmer et al. (2022) produce a fascinating tale about platform ecosystems as meta-organizations. They recognized that these ecosystems consisted of a diverse array of actors, from producers and consumers to complementors and intermediaries. As these actors interacted within the ecosystem, they shaped the rules, norms, and practices that governed its operations. The researchers found that understanding these dynamics could provide valuable insights for platform strategies. Just before, Cenamor and Frishammar (2021) spun their own story on openness in platform ecosystems. They focused on innovation strategies for complementary products and how the

degree of openness could have profound implications for these products' success. They discovered that striking the right balance between openness and control was critical to ensuring both innovation and stability within the ecosystem. Traveling further back in time, Basole and Karla (2011) embarked on a journey to uncover the evolution of mobile platform ecosystem structure and strategy. They examined the way these ecosystems had transformed over time, as well as the strategic decisions that influenced their development. Through their exploration, they found that ecosystem structure and strategy evolved in response to shifts in technology, market demands, and competitive forces.

6 Discussions

Regarding the distribution of topics over the complete collection of documents examined, although all the topics revealed by the analysis play significant roles in understanding platform ecosystems, Topics #7, #8, #1 appear in the literature with greater frequency. The prominence of these topics is indeed crucial for several reasons. Topic #7 drives growth and expansion in new markets, enabling platform companies to reach a broader user base and capitalize on untapped opportunities. By leveraging network effects, platforms can attract more users and partners, creating a virtuous cycle of value creation. Second, market development strategies often involve continuous innovation, which keeps the platform competitive and relevant. This can include the development of new products or services, as well as improvements to existing offerings, ensuring that the platform can meet the evolving needs of its users and partners. Finally, effective market development strategies can foster customer engagement, satisfaction, and loyalty. By understanding and catering to customer needs, platform companies can deliver a seamless user experience that enhances the overall value proposition of the platform, leading to increased customer retention and long-term success. Innovation (Topic #8) plays a prominent role in platform ecosystems, particularly as it relates to industry-specific models and relationship dynamics. Industry models can serve as blueprints for platform development and growth, offering valuable insights into best practices, trends, and competitive landscapes. By understanding these models, platform companies can adapt and tailor their strategies to suit the unique characteristics of their target industries. Moreover, relationship dynamics within platform ecosystems can significantly impact the pace and direction of innovation. Collaborative relationships between

platform stakeholders, such as users, partners, and complementors, can foster a conducive environment for knowledge sharing and co-creation. Such collaboration can lead to the development of new products, services, and technologies, as well as improvements to existing offerings. By nurturing these relationships, platform companies can effectively harness the collective expertise and creativity of their ecosystem to drive innovation and growth. Value co-creation (Topic #1) is a key aspect of business-to-business (B2B) platform ecosystems, as it highlights the importance of collaboration and joint efforts among various stakeholders in the value chain. The prominence of value co-creation in B2B platform ecosystems can be attributed to several factors. First, B2B platform ecosystems often involve complex interactions among numerous stakeholders, each with their expertise, resources, and capabilities. By engaging in value co-creation, these stakeholders can leverage their unique strengths and knowledge to develop mutually beneficial solutions. Second, value co-creation can lead to increased efficiency and effectiveness in the ecosystem. By working together, stakeholders can identify synergies, streamline processes, and reduce redundancies, ultimately leading to better outcomes for all parties involved. Finally, value co-creation fosters innovation and competitiveness, as stakeholders can collaborate to develop new products, services, and business models that address the evolving needs of the market. This can give B2B platform ecosystems a competitive edge and drive long-term success.

Regarding the topics less present in the literature (#15, #10, #20 they are less present in the literature mainly because they focus on more specific aspects of platform ecosystems: Topic 15 (Control and Quality: Governance Mechanisms, Partner Modes, and Access Offerings) discusses governance mechanisms and partner modes in platform ecosystems, which are narrower aspects of the broader platform governance topic. This topic tends to be covered in more specialized literature, as it is more relevant to platform practitioners and experts who are interested in the detailed implementation of governance structures. Topic 10 (Project Scenarios: Diverse Campaigns, Media, and Policy in Practice) concentrates on specific cases and practical examples of platform projects. While these practical insights are essential for understanding the real-world implications of platform strategies, they may not be as widely discussed in academic literature, which often emphasizes theoretical foundations and broader principles. Topic 20 (Business Ecosystems in Enterprise Internet: Mechanisms, Processes, and Cross-Border E-commerce) addresses business ecosystems in the context of enterprise

internet and cross-border e-commerce. This topic is narrower in scope compared to other topics that discuss more general platform ecosystem concepts. Additionally, the rapid pace of change in the e-commerce landscape might lead to a scarcity of long-term studies and comprehensive analyses in this area.

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Appendix

Query

- https://www.webofscience.com/wos/woscc/summary/48eef24c-5df8-438a-b888-ea46df99c109-8224f89e/relevance/1
- 351 results
- "platform* ecosystem*" (Topic) and Early Access or Editorial Material or Book Chapters or Correction or Book Review (Exclude – Document Types)

Stop words

analysi, articl, author, chapter, china, cooper, design, find, implic, literatur, paper, research, result, studi, approach, issu, number

Table 1 – Topic modeling analysis

term	1	term	2	term	3	term	4	term	5
platform	10,5	**servic**	20,8	**data**	9,70	**econo**	9,06	**firm**	11,4
ecosyste	7,36	**platform**	9,73	**platfor**	4,41	**compa**	6,69	**platform**	11,3
valu	7,36	**ecosystem**	4,86	**power**	3,13	**organ**	5,51	**dimens**	3,04
actor	3,68	**impact**	2,30	**market**	3,04	**platfor**	3,54	**open**	2,91
activ	3,09	**environ**	2,03	**polici**	1,86	**role**	3,35	**produc**	2,64
practic	2,72	**concept**	1,89	**govern**	1,76	**patter**	3,15	**content**	2,38
value_co	2,35	**custom**	1,76	**infrastr**	1,76	**proces**	2,95	**system**	2,38

framewo	2,21	health	1,76	compet	1,67	compe	2,76	effect	2,25
role	1,91	provid	1,76	mediu	1,67	theori	2,56	user	2,11
value_cr	1,91	respons	1,76	servic	1,57	transf	2,36	ecosystem	1,72
term	**6**	**term**	**7**	**term**	**8**	**term**	**9**	**term**	**10**
platform	9,55	platform	28,4	innov	12,4	system	6,45	project	4,52
evolut	5,59	ecosystem	12,7	develo	9,72	model	5,91	campaign	3,46
carbon	4,86	strategi	5,98	ecosyst	9,30	techno	5,00	divers	3,46
chang	4,14	market	1,99	platfor	7,74	data	4,09	scenario	3,46
stage	3,06	develop	1,77	industr	2,56	platfor	3,64	medium	3,19
condit	2,34	particip	1,77	model	2,06	inform	3,45	place	3,19
event	1,80	case	1,63	relatio	1,99	manag	3,27	polici	3,19
growth	1,80	challeng	1,63	theori	1,99	tool	2,18	student	3,19
model	1,80	context	1,31	process	1,92	level	1,91	engin	2,66
servit	1,80	busi	1,27	polici	1,56	metho	1,82	develop	2,39
term	**11**	**term**	**12**	**term**	**13**	**term**	**14**	**term**	**15**
platform	9,34	business_m	7,42	produc	18,3	knowl	8,36	control	11,8
govern	9,02	industri	5,77	platfor	7,69	softwa	6,94	qualiti	9,57
aspect	2,76	ecosystem	5,22	market	7,27	comm	3,47	mode	5,94
theori	2,65	busi	4,53	firm	3,78	techno	3,47	partner	5,61
attent	2,55	network	4,53	entri	3,08	iot	2,37	governance_	5,28
cost	2,23	platform	4,26	seller	2,66	develo	2,21	access	2,64
concept	2,12	transform	3,16	game	2,52	collab	2,05	offer	2,64
work	2,12	innov	3,02	innov	1,96	busi	1,89	relationship	2,64
insight	1,91	capabl	2,47	perfor	1,96	phase	1,89	portfolio	2,31
commun	1,80	compani	2,34	sale	1,96	resour	1,89	taxonomi	1,98
term	**16**	**term**	**17**	**term**	**18**	**term**	**19**	**term**	**20**
comple	25,0	applic	14,0	platfor	11,1	platfor	12,3	busi	15,2
ecosyste	11,8	entreprene	5,84	app	6,88	consu	6,30	ecosystem	10,2
govern	4,94	user	3,34	perfor	5,56	marke	4,52	enterpris	6,38
platform	4,49	develop	3,17	effect	5,43	valu	3,09	internet	3,70
innov	3,74	entreprene	3,01	develo	4,71	invest	2,97	mechan	3,29
power	3,14	attent	2,67	mecha	3,26	model	2,97	process	3,09
resourc	2,69	import	2,00	googl	2,42	user	2,73	crossborder_e	2,88
softwar	2,25	application_	1,84	user	2,42	manuf	2,62	chain	2,47
comple	1,95	domain	1,84	compat	2,05	price	2,62	empower	2,47
rule	1,80	gap	1,84	appl	1,69	cost	2,14	model	2,47

Phygital Approach to Value Co-creation in Cultural and Creative Sector

Laura Clemente*

Department of Sciences of Antiquity
Sapienza University of Rome, Italy
Piazzale Aldo Moro 5, Rome

Gesualda Iodice

Department of Economics Management and Institutions
University of Naples Federico II, Italy
Via Cintia 21, Naples

Francesco Carignani

Department of Economics Management and Institutions
University of Naples Federico II, Italy
Via Cintia 21, Naples

Francesco Bifulco

Department of Humanities
University of Naples Federico II, Italy
Via Marina Nuova 33, Naples

* *Corresponding author*

Abstract

This research work is part of the emerging paradigm outlined using phygital approaches for the experimentation of innovative forms of use of the *Cultural Heritage*. The conceptual framework outlined is the field of investigation in which the cultural-based experiences that combine the proposition of physical and digital value in a national and international area are explored from a managerial point of view. The research objective is pursued through a qualitative approach that aims to provide a theoretical understanding and explanation of the phygital phenomenon in the cultural sector. The innovativeness of the proposal is expressed in the comparative analysis of the selected cases, with the purpose of identifying best in class and prospects for improvement. The research's findings highlight that the phygital formula can take on different characteristics depending on the

technologies used and the purpose to be achieved and can be a useful tool for the co-creation of cultural value.

Keywords: Phygital, Cultural Heritage, Digital Technologies, Value Co-creation

1 Introduction

In a glocal scenario where organizations are called to offer value on a global and local scale, the use of the most modern and innovative technologies is a driving force for organizations. In the cultural and creative context, the emerging needs of the subjects see an integration of their actions with other stakeholders, through digital communities of the community without spatial barriers, in an increasingly hyper-connected world, thus requiring management capable of associating the functions of cultural heritage to the development of quality visitor experiences (Bec et al., 2019). In this direction, modern digital technologies are an indispensable tool for designing cultural itineraries capable of providing dynamic approaches to cultural-based fruition (Sfodera et al., 2020). The management of a systemic approach for the enhancement and use of cultural experiences based on intelligent digital and virtual systems is expressed in the activation of value co-creation processes (Kelly et al., 2017) that allows new forms of interaction and collaboration between the various stakeholders and in particular between value-creating organizations and customers in the development processes of new products and services (Füller et al. , 2009) based on culture. This research work aims to explore a range of selected case studies that have implemented the phygital approach to create and co-create cultural and participatory value with all the stakeholders involved.

2 Literature review

2.1The use of innovative technologies in the cultural and creative sector

In a society daily overexposed to the use of technologies, scholars and practitioners are called to deal with rapid social, cultural, and environmental changes. In this direction, technological innovations imply a paradigm shift in the design of value creation processes that organizations convey to their stakeholders.

In the cultural and creative sector, cultural organizations are paying increasing attention to the challenges and pressures arising from the environment in which they are placed, consistent with the complexity of the hypercompetition of the contemporary scenario. In this direction, the use of the most innovative technologies plays a fundamental role in ensuring innovation and authenticity in shaping value for its stakeholders (Chung et al., 2015), implying the need for adequate tools and capabilities (Sfodera et al., 2020). In the same way, the innovative technological component also has a considerable impact on the user experience, intervening in the pre visit, during visit and post visit of visitors. The interplay between the use of innovative technologies and the proposition of cultural value is the subject of numerous studies related to the managerial field (Antoniou & Lepouras, 2010, Russo-Spena et al., 2021). The potential through which innovative technologies intervene in the processes of creating cultural value, including preserving, enhancing, inform, educate visitors to the cultural experience, and provide opportunities for visitors to interact proactively with the cultural organization. The managerial literature reveals wide attention to the use of innovative technologies for the involvement of its stakeholders through the design of proactive and interactive processes that follow the logic and dynamics of multidirectional interaction between the organization and the different stakeholders that gravitate in its orbit. A clear example of this is the emphasis placed by scholars on the increasing application of Augumented Reality in cultural contexts (Do et al., 2020), on a par with Virtual Reality (Williams & Hobson, 1995). In reference to the design of structured fruitive experiences on the components of augmented and virtual reality, it is interesting to note the evolution about the perception that cultural management has had of their use. Despite the initial hostility due to the interpretation of these tools as potential alternatives to museum visits (Guttentag, 2010), recent studies reveal an increasing use of these technologies by cultural organizations in line with the attractiveness and multidimensionality on which they are based, able to effectively involve visitors (Passebois-Ducros, 2019).

The managerial literature reveals important contributions also in reference to the planning of exclusively virtual fruitive experiences in the forms of Virtual Tours (Caspani et al., 2017), able to reach audiences distant from the cultural value by type, origin and preferences. Further output related to the use of innovative technologies in the creation of cultural value is the definition of strategic and operational trajectories in digital environments, with particular attention to the

use of social media. Recent studies reveal that social media are particularly influential in the relationship between users and subjects related to culture (Vassiliadis & Belenioti, 2017; Liang & Martin, 2021; Maniou, 2021). Digital environments represented by social media and technology platforms are a powerful tool to support cultural management. The benefits of developing and implementing technology driven projects such as digitalization and virtualization are in fact multiple.

The use of innovative technologies provides complex information about the target achieved, allows you to profile it and also to intercept the socio-demographic and behavioral characteristics of users (Gargiulo & Carignani, 2022).

As evidenced by the proposed contributions, the literature on the dialogue between contemporary needs and the management of cultural heritage highlights the role-played using technology in the creation of innovative cultural experiences, as well as in the level of competitiveness of the organizations that use it and the territories in which they are located (Greco, 2022; Russo-Spena et al., 2022).

2.2 The role of phygital formula in shaping cultural value

The ability of digital technologies to overcome physical environments by projecting complex systems of intuition and involvement in a web of physical and digital contexts (Mele & Russo-Spena, 2021) reflect a novel architecture of the interactions between the value-creating enterprise and the target audience/consumers to whom the value is destined. It is within this paradigm that fits the phygital approach, whose conceptualization responds to a link between the digital functions and the physical experience of the customer and vice versa (Batat, 2020). The interest of the scientific community towards this emerging phenomenon is remarkable (Debono, 2021; Mele et al., 2021; Greco, 2022; Mieli, 2022) and highlights the opportunities that the phygital approach represents for organizations that choose to apply it.

The declinations to which this conceptualization opens are complex and multiple, and reflect the social, cultural and economic changes that have recently occurred on the national and international scene (Mieli, 2022).

In the cultural and creative sector the emerging hybrid logics of visit and relationship with the public of is able to transform define new scenarios of protection, conservation, and cultural enhancement (Carignani et al., 2023). The

design of visit experiences based on the dialogue between physical and virtual environment involves a growing number of actors and stakeholders (Sahasranamam & Soundararajan, 2021; Del Vacchio et al., 2020) even less sensitive to art and culture, such as young adults, tending to activate online and offline interactions during the visit and enjoyment of the cultural experience (Combes, 2009; Mele et al, 2021). The key to understanding the structures of the phygital formula and the superstructures through which this formula can attract and engaging current and potential audience of visitors lies in the strong involvement that is active. This approach, in fact, through the logic of involvement on which it is structured (Lee et al., 2018; Bec et al., 2019; Little et al., 2020), reflects an effective response to the need to value with innovation the tourist experience (Ballina et al., 2019) and cultural. Recent studies show that the enjoyment of phygital experiences is associated with asset values such as immediacy, immersion, and interaction (Taheri et al., 2019). In this direction, the result of the overlap between physical experiences and virtual or digital dimensions is a fruitive experience characterized by its uniqueness, rarity, and memorability (Johnson & Barlow, 2021). Furthermore, the results that can be achieved using this approach, from a management point of view, consists of elevating the quality of the cultural experience because each stakeholder involved generates, collectively, a value greater than the sum of the value created by each if single (Pera et al., 2016).

As evidenced above, the literature focused on the emerging phygital paradigm highlights an intrinsic link capable of canceling the distances between the physical experience of fruition and the use of the functionalities given by technological innovations (Virgo et al., 2019, Batat, 2020).

3 Methodology

To investigate the promising connection between cultural industries and phygital technologies, the authors adopt a qualitative approach (Dubois & Gadde, 2002) and, considering the purpose of the present contribution, five cultural enterprises are analyzed following the case approach of multiple study (Ying, 2013). The authors also made use of secondary sources such as interviews, website content, social media pages, and industry reports (Creswell & Creswell, 2017).

The five selected cases are the Ara Pacis Museum, the National Archaeological Museum of Naples (MANN), the Australian Center for the Moving Image (ACMI), the Jean Paul Getty Museum and the Tate Modern in London. These subjects all pertain to the cultural sector although they present different characteristics linked to size, collection, and geographical location. Furthermore, the choice fell on these subjects also for the type of activity they share in the approach to digital technologies and, as it will be seen, to technologies that exploit a phygital approach, thus presenting some differences and similarities.

4 Findings

The phygital approach makes it possible to build a holistic experience where the tangible and intangible dimensions of cultural heritage merge. Nevertheless, a phygital cultural ecosystem cannot present univocal elements due to the large number of technologies that can be implemented and the different aims that can be achieved.

The projects carried out by the five organizations analyzed make use of different technologies to enrich the visitor experience and to propose a new and interactive way of learning, contributing to the co-creation of value.

At the end of the section, a summary table is proposed to make the main activities of each selected cultural institution more intuitive, including the best in class with which they exploit the opportunities arising from the phygital approach.

The Ara Pacis Museum is a museum built around the Ara Pacis in Rome, With the project *L'Ara com'Era,* citizens and tourists can enjoy an innovative experience thanks to the combination of different technologies and the creation of virtual worlds in which both real characters and computer-generated reconstructions are inserted. Using special AR visors (Samsung GearVR) and the camera of the devices inserted in them, virtual and real elements merge directly into the visitors' field of vision (arapacis.it). The virtual content appears to the visitor as anchored to the real objects, contributing to the effectiveness and immersiveness of the entire experience, approaching new and younger target groups and creating added value for the audience.

National Archaeological Museum of Naples (MANN) is an international player with the mission of preserving and enhancing ancient artifacts from Egyptian, Greek, and Roman culture. The museum uses immersive technologies for many of

its temporary exhibitions to make the visit more dynamic and to propose new interactive learning models. One example is the Nuragica exhibition, which included an immersive tour entirely dedicated to the archaeology of Sardinia and specially designed to bring it closer to a wider audience.

The ACMI is the Australian national museum of cinema, television, video games and art and has the history of the moving image as its main theme. It has developed an innovative multi-platform model whereby customers can engage with the museum and enjoy the exhibitions in different forms and contexts. Thanks to a new experience operating system (XOS) and appropriate storytelling, the museum can offer an integrated journey that extends and enriches the visitor's experience, making it highly accessible and more multi-faceted.

The Getty Museum is divided into two locations (Getty Center and Getty Villa), both in Los Angeles, one of which (Getty Villa), in Malibu, mainly houses works of ancient art. During the pandemic caused by Covid-19, the museum promoted a challenge on its social channels that encouraged users to reinterpret one or more masterpieces housed at the Getty. Through this challenge the museum showed a virtual complement to its physicality and an effective marketing tool to increase its brand awareness. Thanks to this initiative, the museum has made users prosumers, because they are both users and creators of content, and was able to promote its vast artistic heritage.

The Tate Modern is in London and is part of the complex of the four Tate museums and is focused on modern art, with a very high number of visitors who qualify it as the most visited modern art museum in the world. The museum is at the forefront of the use of new technologies that can provide the viewer with new keys to understanding the works on display. The use of artificial intelligence is adopted in various exhibitions to make works of art sensitive to stimuli from visitors so that they can react to their surroundings and create interactions with the public. Tate Modern therefore can offer a visiting experience in which digital technology is an inherent component, allowing the viewer to become a protagonist of the artwork.

Table 1. Phygital projects best in class carried out by cultural institutions

Country	Name	Main Activity	Phygital projects
Italy	Ara Pacis Museum	Protect, preserve, and enhance the monument of the Ara Pacis through its musealisation.	Implementation of AR, VR and 3D technology to recreate the monument as it was in antiquity.
Italy	Archaeological National Museum of Naples (MANN)	Develop and disseminate knowledge through the conservation and enhancement of ancient artifacts.	Design of an immersive tour using Virtual Reality to create a chronological and multisensory journey in which works of art seem to come alive.
Australia	Australian Centre of the Moving Image (ACMI)	Celebrate and enhance the moving image and its profound impact as it transports, challenges, and entertains people of all ages and backgrounds, right across the globe.	Implementation of a multiplatform model powered by a new experience operating system (XOS) that offers a deeply integrated journey and enriches the visit.
California	Getty Museum	Inspire curiosity about and understanding of the visual arts by collecting, conserving, exhibiting, and interpreting works of art of outstanding quality and historical importance.	Use of social media to invite virtual visitors to reinterpret and perform the great masterpieces of art history during the lockdown caused by the Covid-19 pandemic.
United Kingdom	Tate Modern	Share and celebrate the artwork collection to deepen understanding of its importance and promote it to the world.	Use of Artificial Intelligence (AI) in an art installation to make the works receptive to sensory stimuli in the space and to the warmth of visitors' bodies.

Source: Author's elaboration

5 Implications

The originality of the contribution lies in the comparative analysis proposed among the selected case studies, of which it is intended to intercept best practices and prospects for improvement of an emerging phenomenon in the management literature of the cultural sector.

From a theoretical point of view, this paper contributes to the debate on the application of the phygital approach in the cultural sector. The literature review highlights that interest in phygital practices is on the rise, although the empirical cases are still lacking. From a managerial point of view, the present study highlights how the fusion of the physical and digital environment is of great relevance for cultural enterprises as it participates in the generation of new value propositions for the different types of stakeholders involved. In particular, the impact that the phygital formula can have on customers is pointed out, to understand how it can be integrated at the management level for the enhancement of cultural heritage.

6 Conclusions

This work wants to be the starting point for an ever-greater study of cultural dynamics using a phygital approach. If on the one hand the budgets of the institutions still seem to be ill-suited to these investments, on the other these technologies are becoming increasingly accessible to cultural subjects. The Covid-19 pandemic has certainly contributed to speeding up these processes. If the cultural sector is therefore extremely lively and open to new technologies, however, the core of personnel remains, often not very specialized in interacting with these tools. In this sense, the advent of the Metaverse could be another factor in the strong development of new technologies, increasing more and more the phygital approach, and facilitating the formation of real cultural communities, capable of making these institutions live not only as simple places, venues for art collections, but as actors capable of uniting and supporting the creation of new and shared values.

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Does I4.0 Guarantee Inclusiveness and Accessibility? Evidence from Multimedia Immersive Exhibitions

Angelo Bonfanti*

University of Verona
Department of Business Administration
Via Cantarane 24, 37129 Verona (Italy)

Rossella Canestrino

Parthenope University of Naples
Via Generale Parisi 13, 80132 Naples (Italy)

Francesco Caputo

University of Naples 'Federico II'
Department of Economics, Management and Institutions
Via Cintia, 21 – 80126 Napoli (Italy)

Elias G. Carayannis

The George Washington University School of Business
Department of Information Systems & Technology Management
515 Funger Hall, 2215 G Street NW, GWUSB,
Washington, DC 20052, USA

Pierpaolo Magliocca

Department of Humanities
University of Foggia
Via Arpi 155, 71121 Foggia (Italy)

Erika Rescigno

University of Foggia
Via Arpi 155, 71121 Foggia (Italy)

** Corresponding author*

Abstract

Immersive multimedia exhibitions – which are based on digital images, light effects, and soundtracks – are developing in most of museums worldwide to enhance the customer experience. However, not all visitors such as disabled people can enjoy them. Previous studies that have so far examined the accessibility and inclusion of disabled people in museums are very few. This research aims to investigate how I4.0 can guarantee inclusiveness and accessibility of disabled people in immersive multimedia exhibitions. In this purpose, a single case study engaged in good practice was performed by examining an immersive multimedia exhibition in Italy. This study provides specific aspects and solutions devoted to more inclusiveness and accessibility that could serve as a starting point for designing future immersive multimedia exhibitions. The results of this research have theoretical and practical implications.

Keywords – Technology, Inclusiveness, Customer experience, Museum, Immersive exhibitions

Paper type – Academic Research Paper

1 Introduction

Most of museums are re-inventing their experiential offering to broaden their attractiveness (e.g., Batat, 2020). Technologies are adopted to enhance the customer experience (e.g., Neuhofer et al., 2014) such as interactive devices and websites, social media, mobile applications, as well as augmented and virtual reality (e.g., Bird et al., 2022; Trunfio et al., 2022). Also, multimedia technologies such as museum exhibitions and, especially, immersive multimedia exhibitions are developing in museums to enhance the visitors' experience (e.g., Luo, 2020) by creating an interactive experience to disseminate knowledge and culture. They are based on digital images, light effects, and soundtracks that are projected and spread in a physical space where the visitor moves.

These exhibitions provide unique and memorable experiences for their visitors. However, not all customers can enjoy them such as disabled people because the space, installations, and the employed technology do not meet their specific needs.

Previous studies that have so far examined the accessibility and inclusion of disabled people in museums are very few (e.g., Devile and Kastenholz, 2018; Loureiro et al., 2019; Vaz, 2020). Only few academic contributions are starting to investigate the adoption of immersive technologies in this research field (e.g.,

Devile and Kastenholz, 2018; Loureiro et al., 2019). Thus, further research is needed about issues related to inclusiveness and accessibility because millions of people worldwide are temporarily or permanently impaired. Thus, the following research question emerges: How can I4.0 guarantee inclusiveness and accessibility of disabled people in immersive multimedia exhibitions?

This study aims to answer this question by exploring a single case study engaged in good practice. Especially, it takes in account an immersive multimedia exhibition in Italy by aiming to examine specific aspects and solutions devoted to more inclusiveness and accessibility that could serve as a starting point for designing future immersive multimedia exhibitions.

The structure of the paper is as follows. After presenting the theoretical background, the method is described, as well as the results are analysed and discussed. The study concludes with implications, limitations, and future research lines.

2 Theoretical background

Digital, visual and information technologies are transforming all service experiences (Bogicevic et al., 2019). Technologies such as the Internet of Things, near-field communication and artificial intelligence are assisting the service industry to create unique and memorable digital experiences. In this perspective, technology is not a mere tool, but an integral part of the organization in creating a compelling customer experience. In this regard, Frochot and Batat (2013) argued the importance of engaging multiple senses to provide atmospheres that deliver an immersive experience involving feelings and senses. Different physical elements can help to produce atmospheres. For example, the Guinness Storehouse, a former Guinness brewery, has been transformed into a visitor attraction interpreting the history and production of Irish heritage. Innovative interactive technologies offer visitors the chance to smell, touch, see and taste the beer, creating a unique experience through interaction with the environment, named 'landscape of experience' or 'experiencescape' (O'Dell, 2005; Prahalad and Ramaswamy, 2004; Mossberg, 2007). It includes functional spaces enabling the interaction among different stakeholders and capturing the totality of how experiences are produced and consumed in a meaningful whole. It takes an endless number of forms and can manifest itself in cultural expressions such as song, dance, music, and art (O'Dell, 2007). For instance, many former

manufacturing sites in cities have been converted into art galleries or exhibition and entertainment centers, with new aesthetical components and their initial functions replaced by new ones (e.g., Xie, 2015).

Previous studies that have so far examined the accessibility and inclusion of disabled people in museums are very few. For example, Vaz (2020) proposed a framework that combines sensory, intellectual, and physical access into the pre-visit, on-site visit, and post-visit phases of interaction with cultural institutions to promote a sense of autonomy across these people. Furthermore, scholars and practitioners should pay more attention to the role of technology (e.g., Freeman et al., 2016) and, even more, to the adoption of immersive technologies in this research field. In this last regard, Loureiro and colleagues (2019) argued the importance of reducing the negative impacts of tourism using immersive technologies by investing in alternative accessible experiences such as virtual museum experiences. Accordingly, as Devile and Kastenholz (2018) claimed, more inclusive approaches to museums can be provided to promote individual and social well-being. Indeed, the International Council of Museums (ICOM) established that museums invest in safeguarding and communicating their collections to the audience and performing social functions that are the core of their existence. Therefore, further theoretical and empirical research is needed about issues related to inclusiveness and accessibility, which can concern millions of people worldwide because of temporary or permanent impairments during their lifetime.

3 Method

In methodological terms, an explorative study was conducted, by employing a single case study (Corbin and Strauss, 2015) as research approach because it enables in-depth study of a contemporary phenomenon in its real-life context (Yin, 2017). In this regard, the immersive experience of Van Gogh at the Church of San Potito in Naples was considered as case study.

This multimedia immersive exhibition proposes the Dutch painter's flair lives again through an impressive multimedia experience, ready to enchant visitors of all ages once again. An exciting journey for its modern form of technological expression and surprising originality, capable of attracting and involving a heterogeneous audience, from art enthusiasts to young students. "The Immersive Experience" offers people a more unique than rare opportunity: that of literally

inhabiting Van Gogh's works, observing them one by one from a privileged perspective. Indeed, from a multiple perspective: the heart of the exhibition is in fact represented by a room in which 350 masterpieces by the Dutch artist are projected on a loop.

The case study adopted for the analysis allowed in-depth examination about how technologies can allow disabled people to participate to – and receive – an immersive experience. In addition, it provides scholars and practitioners with theoretical understanding of this phenomenon that can be useful for other cases (Yin, 2017) and inspire new ideas (Siggelkow, 2007).

In terms of data collection, an in-depth interview to exhibition managers was performed to propose solutions devoted to more inclusiveness and accessibility that could serve as a starting point for designing future multimedia immersive exhibitions. This method enabled to obtain many ideas and impressions about the topic under investigation by understanding individuals' perceptions and attitudes toward a phenomenon (e.g., Krueger and Casey, 2000). Informants were chosen for their knowledgeability in the topic under investigation as well as their availability to participate to the interviews. The interview guide was designed based on the main themes of the research question. Two interviews were conducted in March 2023. They were conducted by following a conversation with purpose approach, which allows interviewers to vary the detail of the answers, as well as the order of the questions. According to the interpretivist approach, the interview can be seen as a "socially constructed event" (Caruana et al., 2014, p. 120) in which the researcher/interviewer acts as an expert facilitator who stimulates the respondents. The interviews have been undertaken to learn about how the activity of immersive experience is created and specific aspects devoted to more inclusiveness and accessibility. The interviews were digitally recorded, later transcribed, and then checked for accuracy. The recording of the interview made it easier to focus on the interview content and the verbal prompts and thus enables the transcriptionist to generate "verbatim transcript" of the interview. The exhibition's website was used as further source of data collection. All the information that were collected were joined to create the dataset that was used during the next analysis phase.

In terms of data analysis, a series of iterative coding and analysis were conducted by three authors independently to triangulate the initial results. This approach was aimed at reducing the subjective interpretations of the researchers

(Flick, 2000). These independent analyses were then compared collectively to identify the major themes emerged from the interviews.

As a result, narrative constructs about the main topics of the study emerge and are in the following section proposed. This study represents the first step of an on-going research.

4 Results

The main findings emerged from the interviews are related to three themes: a) experiential aspects of immersive exhibition, b) the role of technology in terms of customer experience enhancement, and c) immersive exhibition devoted to inclusiveness and accessibility.

4.1 Experiential aspects of immersive exhibition

The exhibition is immersive as it brings the visitor inside the paintings and life of the painter, as one of interviewees said:

> *"It is the Church itself that becomes the protagonist, comes to life, imbued with the greatness of a genius without time, space or borders. Everything comes alive: the walls, the floor, the doorposts, the arches, the faces of the enraptured witnesses of a unique spectacle. A soundtrack always perfectly in tune with the images as they flow by, contributes to the incomparable atmosphere."*

Compared to the exhibition already presented in Belfast, Madrid, Dublin, Atlanta and Washington, the Neapolitan exhibition is particular for some aspects of the exhibition itself that are not found in the other exhibitions, such as the attention to the part of Parisian life lived by Van Gogh, when he goes to Paris to live with his brother Theo. These years are the most prolific but, at the same time, they are also the years that lead him to mental collapse. In fact, inside the Neapolitan exhibition there is a reconstruction of the asylum of Saint Paul, where the painter voluntarily decides to be hospitalized. He went from a missionary lifestyle, working in mines in Belgium to evangelize miners and farmers, to a bohemian life in Paris where he was introduced into the circle of the greatest artists of the time.

The experience is a total immersion in the world of Van Gogh. The exhibition is much larger, as great attention has also been given to the didactic part, because before arriving at the immersive room there are a series of corridors and panels

that trace the life and works, by giving attention to the Parisian period. One of the interviewees explained that the rooms are placed on two levels:

> *"The first is dedicated to the period in which Van Gogh decided to create a community of painters, and this is due to the fact that the painter seeing a yellow house falls in love with it and believes that yellow is the color of happiness and sees in that house a reference point for painters who could find themselves there and paint together. Then, inside the exhibition there is the reconstruction of the bedroom (which is mainly used as a place for selfies) in Arles to let the visitor enter the picture and immerse himself in the work and life of the painter. Much attention is also devoted to the Japanese period of Van Gogh, who is credited with having opened the doors of European painting to Japanese. So, you can see a choice of more saturated colors and not brighter.*
>
> *At the second level, one can watch a five-minute documentary that sheds further light on the painting techniques used by the great Dutchman."*

The other interviewee added as follows:

> *"The inscriptions, quotations, a warm and welcoming narrator's voice hurl the spectator into the dreamlike universe of a character who was as misunderstood, even despised in life as he is admired, sometimes idolized now."*

Other rooms, less evocative but equally interesting, offer patrons the chance to admire the Flemish artist's most representative paintings. In yet another one, young and old can try their hand at creating and coloring works to take back with them as a souvenir of their visit.

4.2 The role of technology in terms of customer experience enhancement

In the multimedia immersive exhibition of Van Gogh in Naples several technologies play a crucial role. The technology is based on the latest generation projectors, which enable to see high resolution images, and on the use of the Dolby Surround system, as one of the interviewee argued:

> *"Inside the exhibition, the audio is distributed in the room in the same way, so that it is always the same, regardless of point of the room in which the visitor places. In other terms, no points are with louder or lower sound."*

In order to create immersive experience, music is fundamental, as the other interviewee explained:

"The music is very important. In this regard, the musician Thomas Dorsan C., looking at the paintings, has specifically composed multiple music for the exhibition. The music, produced for each painting, contains the notes that the musician felt most similar to the painting taken as an object."

In addition to video mapping, a virtual reality section enables the visitor, wearing the latest generation oculus, to see through Van Gogh's eyes, intent on observing the world and drawing inspiration from the landscapes most familiar to him for his works. Through virtual reality, it is possible to enter right into the mind of the author, trying to imagine at least for a fleeting instant the effect he would make. In the following excerpt of the interview, another specificity of the Neapolitan exhibition emerges to create immersion:

"A latest generation technology is used to project a 10-minute film, which allows the visitor to experience the most total immersion. Compared, for example, with Monet's experiential exhibition, which inside the oculus gives the visitor the opportunity only to admire the landscapes, Van Gogh's Neapolitan exhibition is based on a detailed reconstruction of the painter's feelings while he was painting. This reconstruction was possible thanks to the testimony provided by the correspondence that the painter exchanged with his brother. In particular, it was possible to choose the letters in which the painter expressed his feelings and transform them into a form of narration that visitors listen to while participating in the film thanks to virtual reality, which describes the picture or his life. A very detailed philological work has therefore been done."

4.3 Experiential aspects of immersive exhibition

Van Gogh Experience interacts with the observer, takes him by the hand and invites him to enter the painting. Despite this, this exhibition is designed as immersive for all, disabled people included, such as visitors with impaired vision, hearing, and mobility, as one of the interviewees told:

"Groups of blind people visited the exhibition, but they were able to listen to the music, which, as anticipated, is intended to represent the individual works. In addition, some of the exhibition's escorts had the task of explaining the images. Thanks to music and explanations, visitors with impaired vision can have feelings and emotions.

Visitors with impaired hearing also visited the exhibition. They had the opportunity to observe and immerse themselves in the exhibition."

For people with disabilities, a special protocol is followed in order to go beyond their disability to enable these visitators to enjoy the immersive exhibition. In particular, one of the interviewees spoken as follows:

"Since at the entrance of the exhibition there are stairs, we have provided a different entrance for people with disabilities. Unfortunately, architectural barriers cannot be overcome in order not to damage a historic site such as the Church of San Potito in Naples. Although visitors with disabilities enter through a different entrance, they are then accompanied to the beginning of the exhibition so that they can follow the same path as other visitors."

In this regard, this further reflection was added:

"Surely the exhibition is enjoyable but obviously depends on the disability that affects different people, because the exhibition, for a total immersion of the visitor, needs the mixture of images and music. Given that the immersion creates excitements, also people with disabilities can have feelings and emotions."

In order to make further immersive this exhibition, the managers told their intention of add olfactory and tactile experiences in addition to those visual and auditory, so as to have a 360 per cent immersion of the visitor and, especially, make more inclusive the immersive exhibitions for people with disabilities, through the stimulation of the other senses. In this regard, technology will be once again extremely important:

"The technologies that could be used are electrodes or electro stimulators, room perfumers within the ventilation system, or sensors that release a certain scent upon arrival of the visitor."

5 Discussion, implications, and conclusions

In line with previous studies (e.g., Frochot and Batat, 2013; Bogicevic et al., 2019; Luo, 2020), the case examined highlights how immersive multimedia exhibitions enhance the visitors' experience by creating an interactive experience that is aimed at disseminating knowledge and culture. In this regard, experiencescape and technology play a crucial role.

The interactions that each visitor can create with the environment are multiple. As some scholars argued in literature (e.g., O'Dell, 2005; Prahalad and

Ramaswamy, 2004; Mossberg, 2007), the design of experiencescape enables visitors to be experientially captured in a meaningful whole. Images, lights, colours, and sounds are specifically designed to create a unique experience.

In addition, the results presented emphasize the role of technologies such as digital images, light effects, and soundtracks to create the immersion effect, because they involve feelings and engage multiple senses, as the interviewees told. The findings empirically support previous studies (e.g., Freeman et al., 2016) that emphasize the importance of paying more attention to the role and adoption of immersive technologies in this research field. This aspect is currently developed using virtual reality, thus it is in line with some recent studies (e.g., Trunfio et al., 2022).

In particular, this case enables to outline how some specific aspects and solutions related to the experiencescape design and use of technologies are devoted to more inclusiveness and accessibility. As previous research discussed (e.g., Vaz, 2020), disabled people enjoy immersive experience when they have sensory, intellectual, and physical access into the on-site visit. The results proposed highlight a significant form of attention and care towards this market segment that can equally benefit from some experiential aspects that are the subject of the exhibition provided, if it is carefully designed. In line with studies of Devile and Kastenholz (2018), the case described is an example of inclusion because it promotes individual and social well-being.

This study provides relevant theoretical and practical implications. From the theoretical point of view, this study contributes to open debate about inclusiveness and accessibility in museums, which are still very scarce in literature. This research provides practical evidence that the integration of digital images, light effects, and soundtracks during the multimedia immersive exhibitions can be designed for all visitors, visitors with impaired vision, hearing, and mobility included. In addition, this research extends previous studies about inclusiveness and accessibility in museums and exhibitions (Devile and Kastenholz, 2018), by showing that disabled people can enjoy immersive experience. Especially, in line with past studies (e.g., O'Dell, 2005; Prahalad and Ramaswamy, 2004; Mossberg, 2007; Freeman et al., 2016), this research theoretically supports the importance of experiencescape and technology to enhance visitors' experience with and without disability. Given that the disability does not enable to fully enjoy experience, different elements can be designed to stimulate important emotions in the visitors with disability as physical (e.g., specific access to the exhibition free of

architectural barriers), and social (e.g., storytelling to tell what other visitors can see) elements.

From the practical point of view, this research highlights that the proper type of design technologies can potentially offer visitors a more immersive visit. Our findings suggest that increasing immersive scenes can effectively improve visitors' perceived virtual presence and ease the processing of mental images. Practitioners should pay special attention to using this unique digital AR resource to design a small set of virtual features that are compatible with many products to enhance visitor experiences.

Innovative technologies such as AR can use a digital display to make images more concrete and realistic, which could be compelling. The implementation of new technologies should not only be accompanied by guidance, such as contextual cues to transport tourists to the appropriate environment for optimal understanding of the information, but should also leave room for inclusion and accessibility, to enable even people with disabilities to get a full immersive experience. Although the arts have been acknowledged as a means of cultural transmission, connection and sustainability within particular cultural groups, they have also been recognised as a place for cultural convergence in which different cultural groups and practices come together (Gibson and Connell, 2012). McHenry (2011, p. 42) found that the arts attract "diverse segments of the community" and "bring out many more people".

In order to improve the inclusivity and accessibility aspects of the exhibition, locations must be chosen where there are no architectural barriers, whereas at the Church of San Potito, being a historical site, it was not possible to overcome the architectural barriers, and therefore a different entrance was set up for people with disabilities. Although they enter through a different entrance, they are then accompanied to the beginning of the exhibition so that they can follow the same route as the others, but this is a substantial difference especially in terms of time spent. It is important that disabled people do not feel themselves different or uncomfortable about their disability. In other words, it is important that they are treated like other visitors, so it is advisable not to create different exhibition routes, but as in the case examined, there was only the possibility to establish an alternative route that remain for the visitor with disabilities to overcome the physical barrier, so as to enjoy the exhibition like other visitors.

This study has several limitations that can represent future research opportunities. First, the analysis is based on an in-depth investigation of only one

case of a multimedia immersive exhibition located in Italy. Future studies could expand the analysis to include other multimedia immersive exhibitions in Italy and abroad to detect best practices in the inclusiveness and accessibility perspective. In this regard, an empirical survey with in-depth semi-structured interviews to managers worldwide could be conducted and interesting comparisons could be gathered up with reference to similarities and differences across countries and in relation to different segments of disabled people.

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Needing Less to Have More: Sustainability and the Aesthetics of Restraint

Clemens Kerschbaum

Institute for Data, Process and Knowledge Management
Vienna University of Economics and Business
Welthandelsplatz 1, 1020 Wien, Austria

Abstract

The Global Wealth Report of 2022 reveals that we are wealthier, healthier, and living longer than ever before. However, this doesn't necessarily seem to equate to success as a society. The prevailing view in the western business world is that companies must generate high returns and great profits, which requires precise management and planning based on rational, explicit information and 'profound' knowledge. This view is being increasingly questioned by researchers and practitioners who argue that more is not always better. Instead, an 'aesthetic of the right measure' is needed to achieve long-term sustainability.

This position paper explores the idea of *the right measure* that may also include a shift of what we consider desirable in an organizational context. In the light of current movements towards 'Spiritual Knowledge Management' and 'Responsible Knowledge Management', the field of Knowledge Management may need to shift more towards knowledge creation for the greater good. This requires developing a tacit understanding of the meaning of sustainability and a shift in what is considered to be 'working beautifully' from something technically rational to something sustainable and organic.

Presumably, the only way for a company to achieve sustainability in the long run is to change the premises by which it operates away from the culture of 'more is better' towards what I coin as an 'aesthetic of the right measure'.

Ultimately, being a sustainable company needs to become as aspirational as being a financially successful company is today. This involves a shift of the aesthetic image that we have of success as being mainly drawn to financial wealth. Instead, the aesthetics of restraint involve finding pleasure in needing less. The paper suggests that this shift towards sustainability and organic growth is based on a positive aesthetic image of sustainability and requires a change in decision-making methodology and a strong sense of the organization's true purpose.

Keywords – Organizational Aesthetics, Sustainability, Restraint, Responsible Knowledge Management

Paper type – Academic Research Paper

1 Introduction

Introducing the notion of aesthetics and an aesthetic understanding of the world to the field of Knowledge Management (KM), I would – in line with Antonio Strati´s nontraditional approach to describe the aesthetic understanding of organizational life (Strati, 1992) – also like to start this paper off by giving the reader an idea of potential *'flavors'* of the aesthetics of sustainability. Strati argues, that an aesthetic understanding is an epistemological metaphor, which diverges from analytical descriptions commonly applied to study organizations. However, by means of an aesthetic approach, it becomes possible to show a reader the *"complexity, ambiguity, subtlety and pervasiveness in organizational routine and the richness and plausibility of the knowledge generated by examination of the aesthetic experience"*(Strati, 1992 p. 596).

In other words, this approach allows us to convey knowledge differently than through regular analytic and descriptive means of expression (Taylor & Hansen, 2005). It also allows for subjective interpretations of meaning. This is to be illustrated through the following two stories. The first is fictitious, while the second one originates in practice.

If you are familiar with the works of the German author Heinrich Böll, you probably already know the first story of the fisherman and the tourist:

A tourist wakes up a poorly dressed fisherman who is sleeping in his boat in a harbor on the coast of Western Europe, as he takes pictures of him. The tourist is very polite and asks the fisherman about his catch of the day and why he is not out fishing at sea. He also asks the fisherman if he is not well since he is not working despite the ideal weather.

The fisherman says that, despite the excellent conditions, he would not go out again since he went fishing early in the morning and is already satisfied with his catch for the day, which would even be enough to live from for several days.

The tourist cannot understand why the fisherman does not want to increase the frequency of his trips and enthusiastically describes what the fisherman could achieve if he would only work diligently. He could soon buy an engine for his boat, then a second boat, then employ more fishermen, and eventually own a whole fishing fleet. Then he could open a restaurant, export the catch to other towns and then, then he could retire and finally constantly sit calmly in the harbor and doze, just to go fishing every now and then. The fisherman, after having listened to the tourists explications finally pats the tourist on the shoulder and

replies: "this is exactly what I´m doing every day. I sit calmly at the harbor and doze.", leaving the tourist pensive, at loss for an answer – even a bit envious (Böll, 1994).

The story was Böll's satirical reaction to the German economic miracle (*Wirtschaftswunder*) after World War II, which was characterized by the ideals of hard work and economic success. Instead of following this narrative, the story illustrates how someone without great wealth can lead a pleasant, contented, and happy life just as well as opposed to a life of constant work. Böll expresses criticism of the all-encompassing materialism that goes hand in hand with the pursuit of success and social advancement. At the end of the story, the tourist, who initially presents himself as the successful character, is left with the question of whether he actually works just to not have to work one day or whether work could be a fulfilling part of life. From an aesthetics perspective, we have probably observed it for ourselves while reading the story that it has elicited meaning which a rational description would not have been able to convey. Plus, there might be a number of other things we might reasonably conclude about the situation and the characters involved that come from our intuition and imaginative powers (Strati, 1992). We can essentially put ourselves in the shoes of the two characters and empathize with their worldviews.

The second story that I would like to present is more tied to reality and concerns the renown outdoor brand Patagonia. The company is famous for its radical orientation towards sustainability, despite being a profitable multi-national, billion dollar enterprise. Again, we will first look at a short story – in this case a statement from Yvon Chouinard, the founder of Patagonia, before discussing the implications that arise:

> *"I've been a businessman for almost fifty years. It's as difficult for me to say those words as it is for someone to admit being an alcoholic or a lawyer. I've never respected the profession. It's business that has to take the majority of the blame for being the enemy of nature, for destroying native cultures, for taking from the poor and giving to the rich, and for poisoning the earth with the effluent from its factories. Yet business can produce food, cure disease, control population, employ people, and generally enrich our lives. And it can do these good things and make a profit without losing its soul. [...] Like many people who had their formative years in the sixties in America, I grew up with disdain for big corporations and their lackey governments. The typical young Republican's dream of making more*

money than his parents or of starting a business, growing it as fast as possible, taking it public, and retiring to the golf courses of Leisure World has never appealed to me. My values are a result of living a life close to nature and being passionately involved in doing what some people would call risky sports. My wife, Malinda, and I and the other contrarian employees of Patagonia have taken lessons learned from these sports and our alternative lifestyle and applied them to running a company. My company, Patagonia, Inc., is an experiment. It exists to put into action those recommendations that all the doomsday books on the health of our home planet say we must do immediately to avoid the certain destruction of nature and collapse of our civilization. Despite near-universal consensus among scientists that we are on the brink of an environmental collapse, our society lacks the will to take action. We're collectively paralyzed by apathy, inertia, or lack of imagination. Patagonia exists to challenge conventional wisdom and present a new style of responsible business. We believe the accepted model of capitalism that necessitates endless growth and deserves the blame for the destruction of nature must be displaced. Patagonia and its thousand employees have the means and the will to prove to the rest of the business world that doing the right thing makes for good and profitable business."(Chouinard, 2006)

The presented excerpt stems from the introduction to Chouinard's memoirs about Chouinard Equipment (the predecessor of Patagonia) and Patagonia, titled *'Let my people go surfing'*. And again, after reading just one paragraph on its history and values, we probably know far more about the company and the lives of its members than we would have known from a purely mechanistic description of facts. Even more so, this account provides a snippet of knowledge, which is possible to be extended through the readers intuition and imagination (Strati, 1992).

Now, after those two examples have hopefully given the reader an idea of the advantages that an aesthetic approach to organizational life can have in terms of the knowledge conveyed, we can progress to a more technical-rational analysis and discussion of the main argument that will be presented in the next sections.

2 Revisiting the Goals of Knowledge Management?

The aim of knowledge management has always been to make companies more efficient, productive or innovative by managing the available knowledge resources as best as possible. This is believed to lead to competitive advantage (Alavi & Leidner, 2001; Spender, 1996), a view that builds on Penrose resource-based view of the firm (Penrose, 2009).

Much of what has been said, follows the premise of western management ideals that businesses must generate high returns and great profits for their owners and which requires precise management and planning on the basis of rational, explicit information and 'profound' knowledge. This attitude can be well summarized by the quote that "the business of business is business" (Duska, 1997). To this end, Knowledge Management serves as an important tool to facilitate these desired outcomes in an economy that relies heavily on knowledge and intangible assets (Drucker, 2017).

However, in the last years, both researchers and practitioners have started to question this idea of 'technical rationality', the focus on explicit data, information and knowledge, that are part of the predominant managerial metamyth as Adams & Ingersoll (1990) coined it.

In academia this trend towards more sustainable business practices is represented, amongst others, by an ever growing body of literature on sustainability (Olawumi & Chan, 2018) and a relatively recent uptake of the idea that organizations should be built around their true purpose (e.g. Gast et al., 2020; George et al., 2021; Malnight et al., 2019).

In practice we see similar trends that manifest in new approaches to organizing (e.g. Laloux, 2014; Robertson, 2015) or emphasizing sustainability (e.g. Chouinard, 2006)

Paying closer attention, there can be at least two distinct points of critique identified towards established positions of the mentioned predominant metamyth. The first is concerned with the methodology and basis of decision making and the type of knowledge required therefore. In order to get along well in modern-day complex environments, often referred to as VUCA (volatile, uncertain, complex, ambiguous), it has been argued, that other knowledge apart from analytical, rational knowledge and explicit data is required (Bennett & Lemoine, 2014; Nonaka & Takeuchi, 2019, 2021; Scharmer, 2009; Senge et al.,

2004). Ideas of flexibility and a strong sense for the organizations true purpose are said to be amongst the key drivers for success these days.

The other point of critique is related to the reasons for and effects of doing business as we know it (Chouinard, 2006; Laloux, 2014). It has become evident that unbridled capitalism can have severe effects on the planet. And while we have our hands full trying to get climate change under control, we witness signs of growing dissatisfaction amongst the workforce that has been fueled by the pandemic. Many people perceive their jobs as meaningless peaking in developments like the anti-work movement in the U.S. , where millions of people voluntarily left their jobs (O'Connor, 2022).

Hence, we might subsequently ask whether the initial goal of KM is still adequate in a world, where we basically have unlimited access to explicit knowledge and information through the means of powerful search engines and the rise of AI technologies. Should we not rather reconsider the view that KM is (only) about the most efficient systems that let us save, access and distribute mechanistic knowledge, in favor of a view that draws even more on knowledge of the organization and itself? Instead of managing knowledge about something (particular domain knowledge), we might need to manage knowledge about ourselves i.e. our purpose, values, beliefs or (higher) goals that we aspire.

This idea has already sparked flames in the KM community as can be seen in recent publications on *Spiritual Knowledge* (Bolisani & Bratianu, 2018) and the respective idea of *Spiritual Knowledge Management* (Kaiser, 2023) as well as in the notion of *Responsible Knowledge Management* (Durst, 2021).

Still, it is important to note here that by no means I argue that traditional KM has become obsolete, yet I suggest that it can be enhanced with a new facet that has become relevant over the last two decades. In that, I argue in accordance with Durst (2021) that the aim of KM has to shift towards knowledge creation for a greater good.

3 Introducing Organizational Aesthetics to the field of KM

Having mentioned sustainability, responsibility and spirituality in the realm of KM, this inevitably sets out the question, how ideas that relate to those concepts may be best integrated into an organization or the organizational knowledge base respectively. And while there may be a variety of viable options, I would like to draw attention to a big concept that may do good service as a foundation for

further theorizing. The concept I am referring to is aesthetics, in particular organizational aesthetics that describes the understanding of organizational life on the basis of sensorial perception and the meaning that they elicit in us (Baldessarelli et al., 2022; Strati, 1999; Taylor & Hansen, 2005). As such the concept allows for the consideration of individual and subjective perceptions of the organization that are central to the enactment of an organization's purpose (Kaiser, 2023). Furthermore, aesthetics can build a connection to a system (a sense of 'belonging to') (Ramirez, 1991; Taylor & Hansen, 2005), serve as criteria for judgement (Guillen, 1997; Taylor & Hansen, 2005) and is ultimately part of the epistemic process as all other forms of knowing depend on and grow out of aesthetic experiences (Dewey, 1958; Gagliardi, 2006; Taylor & Hansen, 2005).

Regarding the aspect of aesthetics as part of the epistemic process, scholars of KM may recognize some familiarity with Polanyi's idea of *tacit knowledge,* that builds on the same principle of direct personal experience as a means to acquire new knowledge (Taylor & Hansen, 2005). And obviously, just as tacit knowledge, aesthetics is omnipresent in every human encounter with organizations (Strati, 1999).

4 Sustainability and the Aesthetics of Restraint

To illustrate the potential role of aesthetics for the field of KM, I will draw to the example of sustainability for two reasons. First, it is a very neat and illustrative example, because it poses a big problem for society that has yet to be solved – we know that something has to change, however it seems that hardly anybody is acting, still. Where if not in such an environment could a scientific discipline such as KM earn its laurels, if successful in initiating change. As a remark I need to clarify that I will for the purposes of this argument, refer to sustainability only in terms of ecological sustainability. The argument could, however, also be extended to a wider definition of sustainability but for the sake of clarity it is easier to stick to a narrower definition for now. The second reason is that sustainability requires a change not only in our behavior now, but will require a change in our value system as a society sooner or later. As humans use up far more resources than earth can naturally regenerate[1], the only realistic option so far is to consume less of those resources.

[1] *As according to Global Footprint Network < https://www.overshootday.org/about-earth-overshoot-day/ > (last retrieved April, 10th 2023).*

However, who is going to cut down on something? Who is going to reduce, while others continue as before? An issue that reminds of the classical tragedy of the commons. But is it really?

The answer, can be yes. Yes, if we presume that all individuals seek to maximize their wealth, prospects, mobility or status in form of material goods. Yes, if they follow the prevailing norm of western societies and all societies that aspire to these ideals.

But, what if – and now we can refer back to the story of our fisherman in the introduction – what if we assume that there could be different ideals and values that people find worth aspiring. Maybe the metamyth that we follow currently is not an immutable dogma. When we think back to Böll's concluding remark that the tourist leaves the harbor, thinking that the fisherman has got a point, we grasp a hint of a different worldview that has its own appeal. Then there could actually be a way out of our presumed tragedy of commons. But underlying to that escape is a different frame of reference, a different measurement of what is good – a different aesthetic. We could call it the *aesthetic of restraint*. But actually it is not only the aesthetic of restraint but also an aesthetic of freedom, composure and adequacy. There could be many more words to describe the aesthetic frame of reference that underlies the fisherman's lifestyle, yet we probably cannot make it explicit in all its complexity anyways – and we arguably need not, because we already understood it when reading through the short story in the beginning. What we can describe, however, are the effects of the changed aesthetics we encounter now. What we see is that the frame of reference of what is considered worthwhile pursuing has changed – this is the element of aesthetics as *criteria for judgement* (Taylor & Hansen, 2005).

Shrivastava & Mitroff (1984) have argued that people in organizations act upon shared frames of reference. Thus, in order to change how people act, one has to address the organizations frame of reference and shared meaning. With regards to sustainability, Shrivastava et al., (2017) have developed the notion of aesthetic rationality as completing the predominant paradigm of instrumental rationality to create more aesthetically sustainable organizations.

My argument goes further in that it emphasizes the possibility of almost a total shift away from the premise that companies exist to grow and earn money but rather to first and foremost serve some purpose for its stakeholders or society. This more radical approach follows the second introductory example, the one of Patagonia.

Again, from the short anecdote, we have gotten an idea of the prevalent aesthetics at Patagonia. If Patagonia truly exists to *challenge conventional wisdom and present a new style of responsible business* we indeed have a completely different value system in place. Therein, actions that would, for example, support maximized shareholder value, would not fit and be met with disgust, a feeling that results from aesthetic perception. Hence, what we see at Patagonia is more than an aesthetics-enhanced instrumental rationality but a different overall aesthetic that underlies their approach to business.

Concluding this section, we can state that aesthetics provide a frame of reference for the evaluation of corporate actions alongside the purpose of an organization. Not only does it influence decision-making in the short term but it changes what organizations members consider good or bad, thus potentially leading to a change of the organizations overall behavior.

5 Conclusion

Aesthetics, from an epistemological view is akin to tacit knowledge. Both require direct sensory experience to develop, are highly subjective and almost impossible to capture or make explicit. Yet it has been convincingly argued by authors from both realms that aesthetics and tacit knowledge play a vital role for organizing. As Barnard put it "*the essential aspect of the process [of organizing] is the sensing of the organization as a whole"* that *"transcends the capacity of merely intellectual methods"* (Barnard, 1938 p.235). Thus, KM will probably not be able to 'manage' the aesthetics of an organization in a mechanistic sense. However, knowing that organizational aesthetics not only contains an integral part of an organizations value system, but is also a driving force to strive towards the realization of those values can teach us about the importance of recognizing and valuing subjective experiences and sensory perceptions as a means of understanding and improving organizational performance. Organizations should hence strive to foster experience of all sorts for its members.

With regards to sustainability this could mean to have people interact with their environment as much as possible and to include all senses in the process. Just as we could understand complex aesthetics from two simple stories, people might recognize the aesthetics of sustainability if they only feel the meaning of the concept themselves instead of just reading or hearing about it.

In order to make sustainable businesses happen, people ought to develop a tacit-aesthetic understanding of the meaning of sustainability that ultimately in the future, being a sustainable company becomes as aspirational as being a successful company is today. In (Adams & Ingersoll's (1990) terms, this would represent a change of the managerial metamyth, or, from an aesthetics perspective, it would represent a shift in what is considered to be 'working beautifully' from something technically rational (White, 1996) to something sustainable and organic. Finding pleasure in needing less – the aesthetics of restraint.

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Women Led Firms and Circular Bioeconomy Actions: A Systematic Literature Review

Silvia Tommaso*

Department of Business Administration and Law
University of Calabria
Ponte Pietro Bucci, Cubo 3C
87036 Arcavacata di Rende (CS), Italy

Patrizia Pastore

Department of Business Administration and Law
University of Calabria
Ponte Pietro Bucci, Cubo 3C
87036 Arcavacata di Rende (CS), Italy

* *Corresponding author*

Abstract

This paper is an initial study concerning the role of women in firms in supporting circular bioeconomy practices. Moreover, circular bioeconomy could generate economic opportunities for women, boosting female and green entrepreneurship. The objective of the research is twofold. On the one hand the study investigates whether women-led firms adopt more circular economy practices than men-led businesses. On the other hand, the research investigates whether the circular bioeconomy could generate economic opportunities for women by encouraging female entrepreneurship. To achieve the proposed objectives, a bibliometric analysis and a systematic literature review have been conducted. The results are overall consistent with the research questions. Female entrepreneurs as well as female directors or female employees plays a critical role in achieving sustainable economy and sustainable development, also in social and environmental dimensions. At the same time, the growth of the service sector, stimulated by the transition to a circular economy and bioeconomy, could provide more opportunities for female employment.

Keywords: Circular economy – Bioeconomy – Circular bioeconomy - Women led firms – Female

Paper type – Academic Research Paper

1 Introduction

Many studies have investigated the link between the presence of women in top echelon positions and sustainable practices of firms (Bannò, Filippi, Trento, 2021) and some of these highlight a positive relationship between the presence of female directors and sustainable activities (Beji et al., 2020; Rehman et al., 2020; Saheed Olanrewaju et al., 2020). Women show, compared to men, a greater sensitivity and propensity to promote sustainable growth.

This consideration led us to investigate whether a link also exists between circular bioeconomy practices and the presence of women in the firm.

Circular bioeconomy is necessary for sustainable growth as it allows societies to change the way they design and produce as well as the patterns of consumption promoting regenerative economic cycles. Circular bioeconomy is crucial to achieve the EU Green Deal objectives, the UN Sustainable Development Goals, the Paris Agreement about climate change, and post-COVID-19 economic transformation (Hadley Kershaw et al., 2021).

New technologies that fuse the physical, digital and biological ones (artificial intelligence, robotics, blockchain, Internet of Things, bioelectrochemical engineering, etc.) can be useful for enabling circular business models and could provide solutions to circular economy transformation (Chauhan et al., 2022).

Circular bioeconomy can be defined as more than circular economy and bioeconomy alone: «the circular bioeconomy focuses on the sustainable, resource-efficient valorization of biomass in integrated, multi-output production chains (e.g. biorefineries) while also making use of residues and wastes and optimizing the value of biomass over time via cascading» (Stegmann et al., 2020, p. 5).

In this context, this paper is an initial study concerning the role of women in firms in supporting circular bioeconomy practices. Moreover, circular bioeconomy could generate economic opportunities for women, boosting female and green entrepreneurship (OECD, 2021). Thus the objective of the research is twofold. On the one hand the study investigates whether women-led firms adopt more circular economy practices than men-led businesses. On the other hand, the research investigates whether the circular bioeconomy could generate economic opportunities for women by encouraging female entrepreneurship.

The study is organized as follow. After this introduction, paragraph 2 focuses, on the one hand, on the analysis of some definitions useful for the present

research, and on the other hand, on the development of research questions. Paragraph 3 explains the research methodology. Particularly, to achieve the proposed objectives, a systematic literature review has been conducted. Subsequently the results of the analysis are presented and discussed. Finally, the conclusions illustrate implications, limits and future developments of the research.

2 Background and Research Questions Development

Circular bioeconomy could be interpreted as the sum of or the intersection between the two concepts of circular economy and bioeconomy. Actually, the relationship among circular bioeconomy, circular economy and bioeconomy is complex and not sufficiently defined.

Circular Economy is a new business model for firms and industries to reduce their environmental impact: «a circular economy reduces material use, redesigns materials, products, and services to be less resource intensive, and recaptures "waste" as a resource to manufacture new materials and products» (EPA, United States Environmental Protection Agency, https://www.epa.gov/recyclingstrategy/what-circular-economy#EPA).

The bioeconomy is the renewable component of the circular economy, an economy in which everything is a resource, including waste. According to the definition of the European Commission, «the bioeconomy means using renewable biological resources from land and sea, like crops, forests, fish, animals and micro-organisms to produce food, materials and energy» (European Commission, https://research-and-innovation.ec.europa.eu/research-area/environment/bioeconomy_en).

Circular bioeconomy can be interpreted as a more efficient resource management of bio-based renewable resources by integrating circular economy principles into the bioeconomy (D'Amato et al., 2018). The circular bioeconomy is a framework to reduce the dependence on natural resources; transform manufacturing; promote sustainable production of renewable resources from land, fisheries, and aquaculture; and promote their conversion into various bio-based products and bioenergy while growing new jobs and industries (European Commission, 2013).

With reference to the concepts of circular economy, bioeconomy and circular bioeconomy, Tan and Lamers (2021) highlight that a substantial confusion exists

around the conceptual definitions of circular bioeconomy and the boundaries with the concepts of circular economy and bioeconomy are not clearly defined.

However, circular economy, bioeconomy and circular bioeconomy undoubtedly play a fundamental role to resolve sustainability challenges.

An important contribution in stimulating firms to manage their social responsibilities and sustainable practices (Yasser et al., 2017) is provided by the women operating in firms. Women, also due to their gender characteristics, are generally more sensitive to issues of social responsibility and environmental sustainability (Burkhardt, Nguyen, Poincelot, 2020).

In the light of these considerations, the present study examines the link between presence of women in the firms and adoption of actions of: 1) circular economy; 2) bioeconomy; 3) circular bioeconomy. The first research question is the following.

> *RQ1: Does the presence of women in the firms (as entrepreneurs, managers, members of board of directors) stimulate the adoption of circular economy, bioeconomy or circular bioeconomy practices?*

Moreover, circular bioeconomy could generate economic opportunities for women, boosting female and green entrepreneurship (OECD, 2021). Therefore, the second research question is the following.

> *RQ2: Could circular economy, bioeconomy and circular bioeconomy circular bioeconomy boost female green entrepreneurship?*

3 Methodology and Documents Selection

To achieve the proposed objectives, a systematic literature review was conducted. The research methodology has involved four phases.

In the first phase, documents have been extracted from Web of Science database. Documents have been extracted using specific keywords as follow:

1. (circular econom* or bioeconom* or circular bioeconomy* or environmental sustainab*) AND (women or female or gender) AND (entrepreneur* or manage*);
2. (circular econom* or bioeconom* or bio-economy*) AND (women or female or gender);
3. (circular econom* or bioeconom* or bio-economy*) AND (women or female or gender) AND (entrepreneur*).

The results have been refined by language (English), Web of Science categories, citation topics. A total of 396 documents were identified. Then, duplicates have been removed (22).

The process has been adjusted before actually selecting the final sample. However, it was preferred not to excessively limit the number of articles to be manually screened in order to avoid eliminating documents potentially consistent with the purpose of the research Indeed, limiting the sample too greatly, is a warning flag that affects both the depth and rigor of the review, and it could have serious effects on its results and contributions (Snyder, 2019).

In the second phase, the extracted papers have been screened by reading the title, the authors key words, the WoS keywords and abstracts to ensure consistency with the research questions. A total of 42 documents have been selected and sought for retrieval. After deleting the (3) documents not retrieved, 39 articles have been included in literature review.

The process of selection of the documents are summarized in PRISMA flow diagram (Page et al., 2021) as illustrated in Fig. 1.

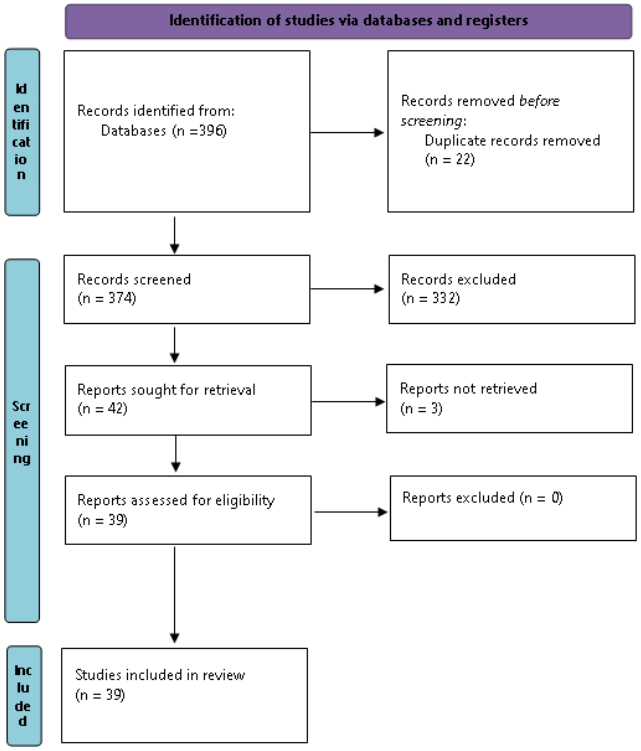

Fig. 1 - PRISMA 2020 flow diagram (Source: Our Elaboration from Page et al. (2021))

In the third phase, a bibliometric analysis on the 39 selected papers has been conducted using Biblioshiny software (Aria and Cuccurullo, 2017).

The fourth phase has been dedicated to systematic review of the selected papers. The systematic literature review has been conducted manually by the authors. The 39 papers have been analyzed in order to highlight, for each paper, results, topic, adopted methodology, investigated firms, geographical area of investigation.

Analysis and results of these last two phases are presented in the next paragraph.

4 Analysis, Results and Discussion

4.1 Bibliometric analysis

The study, through bibliometric analysis, examines keywords; documents and source types; conceptual structure; emerging trends (Donthu et al., 2021).

4.1.1 Documents and sources

The number of documents analyzed is 39 (36 articles and 3 reviews). Although no period restrictions were inserted during the extraction of the documents from the Web of Science, the documents selected manually for the final analysis were published between 2017 and 2023. The Journals in which the papers are published are 23 and the 133 authors have dealt with these topics (Tab. 1).

Tab. 1 – Documents and sources: main information

Description	**Results**
Documents	39
Sources (Journals, Books, etc.)	23
Keywords Plus (ID)	174
Author's Keywords (DE)	187
Period	2017 - 2023
Average citations per documents	27,49
Authors	133
Author Appearances	133
Authors of single-authored documents	3

Authors of multi-authored documents	130
Single-authored documents	3
Documents per Author	0,293
Authors per Document	3,41
Co-Authors per Documents	3,41
Collaboration Index	3,61
Document types	
ARTICLE	36
REVIEW	3

Most cited journals on the topics are:Journal of Business Ethics; Journal of Cleaner Production; Corporate Social Responsibility and Environmental Management; Business Strategy and The Environment (Fig. 2).

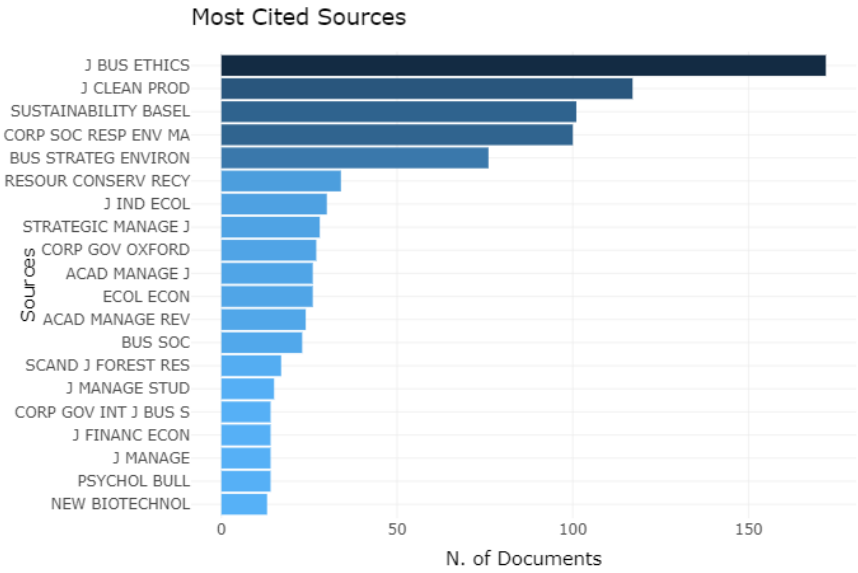

Fig. 2 – Most cited Sources

4.1.2 Keywords

Table 2 shows most frequent words in the abstracts and Figure 3 presents the authors' keywords dynamics: the words "circular economy" and "bioeconomy" appear in dataset with increasing frequency over the years.

Tab. 2 – Most frequent words in the abstracts

Words	Occurrences
gender	64
environmental	61
social	48
circular	45
sustainable	43
female	38
study	38
women	38
sustainability	37
development	34
economy	33
performance	32
management	29
csr	27
business	26
board	25
diversity	21
economic	21
role	21
waste	21

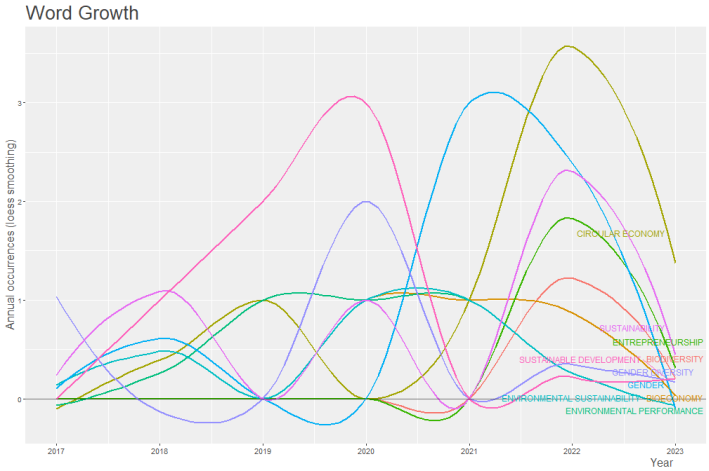

Fig. 3 - Authors' keywords dynamics

4.1.3 Conceptual structure and emergent trend

The analysis of the conceptual structure allows us to identify two clusters (Fig. 4). One (in blue) investigates the links between gender diversity and environmental sustainability. The other (in red) which deals with the themes of the bioeconomy, the circular economy and the circular bioeconomy with those of gender and digitization. In particular, the link between female entrepreneurship, digital transformation and the circular bioeconomy deserves further investigation.

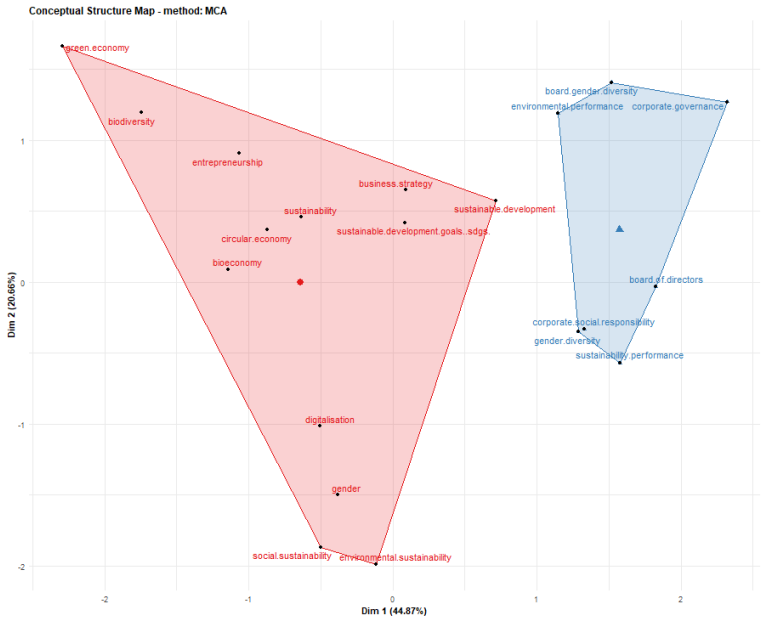

Fig. 4 – Conceptual structure

In this respect, the word "digitalisation" does not appear among most cited keywords and this could indicate the literature gap on the subject that has not adequately investigated the relationship between women-led firms, digitalization, and circular bioeconomy. At the same time, the words "circular bioeconomy" rarely appear together and this also indicates the need to explore both the topic of circular bioeconomy and the link between women-led firms and circular bioeconomy.

4.2 Systematic literature review

The content analysis of the papers has been conducted manually by the authors in order to: 1) identify any factors for which female entrepreneurs promote circular bioeconomy and sustainable practices (and the adoption of suitable technological innovations) more than male entrepreneurs; 2) understand whether and why the circular bioeconomy generate economic opportunities for women.

The evidences of the studies have been summarized and data synthesis is shown in Table 1.

The first research question (*Does the presence of women in the firms (as entrepreneurs, managers, members of board of directors) stimulate the adoption of circular economy, bioeconomy or circular bioeconomy practices?*) is addressed by most of the studies analysed.

Internal values, such as cultural factors and gender characteristics, make women more sensitive to issues of sustainability and reduction of environmental impact also through the adoption of circular economy and bioeconomy practices through reuse, recycling, reduction of waste production.

The results of most of papers included in this literature review confirm that women play a significant role in adoption of circular economy or for improving environmental performance by contributing to reduce the environmental impact of firms. These evidences are confirmed in studies that envolved:

- different sectors: banking industry (Ali et al., 2022; Galletta et al., 2022), tourism (Vila-Vazquez et al., 2023), primary sector (Barrero-Amortegui and Maldonado, 2021);
- different regions or countries: China (Elmagrhi et al., 2019); Spain (Martinez et al., 2019); France (Burkhardt et al., 2020); Australia (Galbreath and Tisch, 2020), etc.

Tab. 1 – Documents included in the review and classification

Year	Authors	Journal	Document type	Methodology	Geographical area of investigation	Investigated firms	Topic	Results
2022	ALI Q; PARVEEN S; YAACOB H; RANI AN; ZAINI Z	Journal of Cleaner Production	Article	Quantitative	Asia (Malaysia)	Banks	Circular economy/Bioeconomy/ Circular bioeconomy	"The results confirm that females … play a significant role in adoption of circular economy by contributing to managers' environmental beliefs"
2022	GALLETTA S;MAZZU S;NACITI V;VERMIGLIO C	Corporate Social Responsibility and Environmental Management	Article	Quantitative	World (48 countries)	Listed banks	Environmental Sustainability	"The results show that increasing the proportion of female directors improves the financial and environmental performance; female managers are keener on the social dimension and in engaging with stakeholders, than female directors."
2019	ELMAGRHI MH;NTIM CG;ELAMER AA;ZHANG QJ	Business Strategy and The Environment	Article	Quantitative	Asia (China)	Listed companies	Environmental Sustainability	The study "finds that the proportion … of female directors have a positive effect on the overall corporate environmental performance. … Findings indicate that the proportion …. of female directors also have a positive effect on the three individual environmental performance components, namely, environmental (a) strategy, (b) implementation, and (c) disclosure."
2023	VILA-VAZQUEZ G;CASTRO-CASAL C;CARBALLO-PENELA A	Service Industries Journal	Article	Quantitative	Europe (Spain)	Hotels	Environmental Sustainability	Findings show "when the supervisor is a woman, the effect of her csr perceptions on employees' csr substantive attributions was stronger. Additionally, women's csr perception also significantly influenced employees' crs symbolic attributions, although to a lesser extent"
2021	BARRERO-AMORTEGUI Y;MALDONADO JH	World Development	Article	Quantitative	South America (Colombia)	Fishing communities	Environmental Sustainability	"The results suggest that integrating women into environmental-management groups is positive for the conservation of natural resources. In practice, women's contribution would be useful only if they can participate actively in decision-making processes".
2019	MARTINEZ MDV;RAMBAUD SC;OLLER IMP	Corporate Social Responsibility and Environmental Management	Article	Quantitative	Europe (Spain)	Listed firms	Environmental Sustainability	"The female presence in management positions is positively linked to a voluntary disclosure of csr reports and the inclusion in a sustainability index, which supports gender legislation"
2020	BURKHARDT K;NGUYEN P;POINCELOT E	Corporate Social Responsibility and	Article	Quantitative	Europe (France)	Listed firms	Environmental Sustainability	The study "finds that firms with more women in top management exhibit higher environmental performance".

		Environmental Management						
2021	ARDITO L;DANGELICO RM;PETRUZZELLI AM	Corporate Social Responsibility and Environmental Management	Article	Quantitative	Europe	Benefit corporation	Environmental Sustainability	"Results reveal that female representation in the bod is not beneficial for each specific csr dimension, albeit it is beneficial at an aggregate level. Specifically, it is positively associated with customers' management and community engagement, negatively related to environmental performance and employees' well-being, and not significantly associated with ethical governance".
2020	GRAAFLAND J	Corporate Social Responsibility and Environmental Management	Article	Quantitative	Europe	SMEs	Environmental Sustainability/Circular economy	The study "hypothesizes that having more women in management positions improves the sustainability of smes. ... Results find support for this hypothesis".
2019	PLA-JULIANI;GUEVARAS	Futures	Article	Quantitative	Europe (Spain)	Entrepeneurial Associations and Enterprises (mainly SMEs)	Circular economy/Bioeconomy/ Circular bioeconomy	Finding show that Circular Economy offers potential challenges and even opportunities for improving gender equality while creating business opportunities or contributing to the achievement of SDGs.
2022	AL-QAHTANI M;ZGUIR MF;ARI I;KOC M	Sustainability	Article	Qualitative and Quantitative	Asia (Qatar)	Highly skilled and skilled (female and male) individuals	Environmental Sustainability	The study "proposes an integrated policy framework for qatar, as a resource-rich country in the quest of transforming into an innovation-driven, knowledge-based sustainable development to propel women's entrepreneurship and increase their involvement in achieving economic diversification, and thus, sustainable development in a broader perspective. The framework is followed by a survey validation... Results show that several female participants, mainly qatari nationals, are willing to become entrepreneurial investors to help fund other entrepreneurship startups to partner with other women and give back to society and contribute to the overall sustainability of their community".
2020	GALBREATH J;TISCH D	Australasian Journal of Environmental Management	Article	Quantitative	Oceania (Australia)	Wime firms	Environmental Sustainability	"The results suggest that women in the operations manager role are positively associated with environmentally sustainable practices, while women in the CEO role are not. However, when women are in both CEO and

								operations manager roles in the same firm (interaction effect), the relationship with environmentally sustainable practices is positive and significant".
2022	BOZKURTO;XHENETIM;VICKY	Work Employment nd Society	Article	Qualitative	Europe (UK)	SWIM AND ACTIVE WEAR firm	Circular economy/Bioeconomy/ Circular bioeconomy	"This article traces the experiences of vicky, a female entrepreneur who runs a circular business that produces swim and activewear from regenerated fishing nets. ... Vicky's story highlights the often overlooked but critical role of small businesses and their owners in this systemic change. Vicky performs three intertwined but distinct forms of work - entrepreneurial work on the business, identity work on the self and institutional work on the wider world - that all contribute to the circular transition. At the same time, vicky exemplifies an alternative approach to entrepreneurship through a relational interpretation of circularity".
2017	BEN-AMARW;CHANGM;MCILKENNY P	Journal Of Business Ethics	Article	Quantitative	North America (Canada)	Listed firms	Environmental Sustainability	The study finds that the likelihood of voluntary climate change disclosure increases with women percentage on boards. We also find evidence that supports critical mass theory with regard to board gender diversity".
2020	ORAZALIN;BAYDAULETOV M	Corporate Social Responsibility and Environmental Management	Article	Quantitative	Europe	Listed firms	Environmental Sustainability	The study "examines the effects of corporate social responsibility (CSR) strategy and board gender diversity on environmental and social performance. ... The results show that board gender diversity is positively associated with environmental and social performance".
2022	PENG XH;SONG Y;YEUNG D	Polish Journal of Environmental Studies	Article	Quantitative	World	Multinational corporations	Environmental Sustainability	Results "find that board gender diversity positively affects the environmental disclosure".
2022	TOVMASYAN G	Marketing and Management of Innovations	Article	Quantitative	Asia (Armenia)	Women who have or plans to start a business in tourism	Environmental Sustainability	Most of the women interviewed declare to pay attention to environmental issues
2018	CALABRESEA;COSTAR;GHIRONNL;MENICHINI T	European Journal of Sustainable Development	Article	Qualitative	Europe	-	Environmental Sustainability	"The results show that the mean female share of employment in senior and middle management is growing, and that managerial roles in CSR are a gender-virtuous field of management. ... An analysis of Corporate Knights‟s ranking of the world‟s most sustainable corporations reveals that the female share of CSR managers is not directly linked to the presence of

								sustainable corporations".
2021	AHMAD N;ULLAH Z;MAHMOOD A;ARIZA-MONTES A;VEGA-MUNOZ A;HAN H;SCHOLZ M	International Journal of Environmental Research and Public Health	Article	Quantitative	Asia (Pakistan)	Hospitals	Environmental Sustainability	"The … study investigates the impact of micro-level CSR (MCSR) on employees' pro-environmental behavior. … The results revealed that MCSR positively influences employee's pro-environmental behavior, and gender moderates this relationship but the moderating effect of females is stronger as compared to males".
2021	EL WALI M;GOLROUDBARY SR;KRASLAWSKI A	Science of the Total Environment	Article	Quantitative	World	Global phosphorus supply chain	Circular economy/Bioeconomy/ Circular bioeconomy	"Circular model fails to promote gender equality"
2022	DE OLIVEIRA JAP;MUKHIU;QUENTAL C;FONTES PJDC	Business Strategy and the Environment	Article	Qualitative	South America (Brazil)	Cluster of quebradeiras in Lago do Junco	Circular economy/Bioeconomy/ Circular bioeconomy	The study show that women entrepreneurs "have developed organizational activities that address persistent social, economic, and environmental challenges. Through community organizing, the quebradeiras maintain a traditional activity, connect with gvcs, and protect the biodiversity of the regional ecosystem".
2021	ABD-MUTALIB H;JAMIL CZM;MOHAMED R;SHAFAINA;NOR-AHMAD SNHJN	Sustainability	Article	Quantitative	Asia (Malaysia)	Listed firms (telecommunication and technology Industries)	Environmental Sustainability	The "study investigates the extent and quality of e-waste disclosure". … Board gender diversity show insignificant impact on e-waste disclosure.
2018	OLUKANNIDO;OLATUNJI TO	Recycling	Article	Quantitative	Africa (Nigeria)	Cassava processors	Circular economy/Bioeconomy/ Circular bioeconomy	"Results … reveal that 86.3% of cassava residues are used for animal feeds. Other findings show that the peels, when dried, are used as biofuel for cooking and there is a significant potential for biogas production. From the data captured from respondents during the study, most processors are willing to pay for an improved waste management system…. Results of the analysis show that the majority (70%) of the cassava processors are females".
2019	CHAMS N;GARCIA-BLANDON J	Journal of Cleaner Production	Article	Quantitative	World	Multinational companies	Environmental Sustainability	"The results reveal a significant and positive relationship between sustainability and gender diversity".
2019	FERNANDEZ-ROBIN C;CELEMIN-PEDROCHE MS;SANTAN	Sustainability	Article	Quantitative	Europe (Spain) and South America	Hotels	Environmental Sustainability	"Women are more motivated and see fewer barriers to the implementation of environmental measures in their hotels than do men".

	DER-ASTORGA P;ALONSO-ALMEIDA MD				(Chile)			
2020	LANG LX;WANG YJ;CHEN XP;ZHANG ZL;YANG N;XUE B;HAN WY	Resources Conservation and Recycling	Article	Quantitative	Asia (China)	Restaurants	Environmental Sustainability	In the paper, restaurant owners were surveyed to study their awareness of food waste recycling. Compared with the male restaurant owner, the female one has a lower awareness.
2022	CHINEMEA;ASSEFA G;HERREMANS IM;WYLANT B;SHUMO M	Sustainability	Article	Qualitative	Africa	-	Circular economy/Bioeconomy/ Circular bioeconomy	The "study presents a collaborative Indigenous female institutions' organizational model that applies circular economy concepts and an affordable biowaste management technique which mitigates a regional-specific waste management challenge".
2021	ROOS A;BLOMQUIST M;BHATIA R;EKEGREN K;RONNBERG J;TORFGARD L;TUNBERG M	Scandinavian Journal of Forest Research	Review	Qualitative	Europe (Nordic countries)	Forestry	Circular economy/Bioeconomy/ Circular bioeconomy	The study reviews the existing literature by studying three concepts – bioeconomy, digitalisation and gender – as a way to highlight the current state of knowledge on gender in the Nordic digitalised bioeconomy. Through this investigation the study proposes four areas of future research focus: among these, the women's involvement in the bioeconomy sector.
2023	VAN OPSTAL W;BORMS L	Journal of Cleaner Production	Article	Quantitative	Europe (Flenders)	Startups	Circular economy/Bioeconomy/ Circular bioeconomy	"Female startup entrepreneurs are found to be less inclined to combine multiple circular strategies"
2018	VARELA-CANDAMIO L;CALVO N;NOVO-CORTI I	Journal of Cleaner Production	Article	Quantitative	Europe (Spain)	Farms	Circular economy/Bioeconomy/ Circular bioeconomy	Findings "reveal that rural women are better positioned than others to create businesses based on functional foods from a niche formulation".
2020	JAROSCH L;ZEUG W;BEZAMA A;FINKBEINER M;THRAN D	Sustainability	Article	Quantitative	Europe (Germany)	Wood industry	Circular economy/Bioeconomy/ Circular bioeconomy	The study applies the indicator set of RESPONSA to an exemplary production chain in a case study of laminated veneer lumber produced in central Germany. It was decided to include the indicator "Rate of female employees"
2022	STEPHENSON PJ;DAMEREL L A	Sustainability	Review	Qualitative	-	-	Environmental Sustainability	The study also investigates the link between "sustainable economic models and opportunities for socio-economic development, yet access, engagement and participation by women"
2022	SANZ-HERNANDEZ A;JIMP;ZARAUZ I	Forest Policy and Economics	Review	Qualitative	-	-	Circular economy/Bioeconomy/ Circular bioeconomy	The study investigates also about the "women as potential stakeholders and actors in the transition to bioeconomy"

2022	VIJEYARASAR;LIU M	Business and Human Rights Journal	Article	Qualitative	Asia (Bangladesh)	-	Circular economy/Bioeconomy/ Circular bioeconomy	The study demonstrates how sustainability and gender justice are intimately connected
2022	KANUPRIYA	National Accounting Review	Article	Qualitative	Asia (India)	-	Circular economy/Bioeconomy/ Circular bioeconomy	"'Circularity' ensures a rightful place for women, both as consumers and producers in the textiles economy".
2018	MILLARD J;SORIVELLE MN;DELJANIN S;UNTERFRAUNER E;VOIGT C	Sustainability	Article	Qualitative and Quantitative	Europe	Maker communities	Circular economy/Bioeconomy/ Circular bioeconomy	"In the environmental sustainability impact context, females are more successful than males in relation to sustainable consumption and the circular economy". "Female leaders tend to achieve much higher sustainability impacts than their male counterparts".
2019	WIEBE KS;HARSDORFF M;MONTT G;SIMAS MS;WOOD R	Environmental Science & Technology	Article	Quantitative	World	Countries/Regions	Circular economy/Bioeconomy/ Circular bioeconomy	"The adoption of circular economy measures has diverse impacts on the economy and environmental pressures. Global material extraction is reduced by about 10% compared to the baseline, while the impact on employment is small but positive. In particular, the shift from resource extracting sectors to the service sector will provide more opportunities for high-skilled and female workers".
2022	STOIAN M;BRADL;ZAHARIA A	Frontiers in Environmental Science	Article	Quantitative	Europe	Countries (bioeconomy value added indicator)	Circular economy/Bioeconomy/ Circular bioeconomy	"The results indicate positive relationships between EPI (Environmental Performance Index) and area under organic farming, circular material use rate, ecoinnovation index, energy productivity, ratio of female-to-male labor force participation rate, forest area, Human Development Index, Internet users, livestock production index, new business density, patent applications-residents, tertiary school enrollment, the share of renewable energy consumption in gross final energy consumption, and the proportion of seats held by women in national parliaments".
2022	DIACONASUDE;BOSTANI;CAUTISANU C;CHIRIACI	International Journal of Environmental Research and Public Health	Article	Quantitative	Europe	Countries (bioeconomy value added indicator)	Circular economy/Bioeconomy/ Circular bioeconomy	The study "finds that investment in human development along with innovation, the growing role of women and sound public governance have a positive effect on the transition towards a durable and resilient bioeconomy at the european level. This naturally implies that a combination of social and technological innovation can ensure the rise of a sustainable bioeconomy".

The second research question (*Could circular economy, bioeconomy and circular bioeconomy circular bioeconomy boost female green entrepreneurship?*) is addressed by Pla-Julian and Guevara (2019): their paper shows that circular economy offers potential challenges and even opportunities for improving gender equality while creating business opportunities or contributing to the achievement of SDGs. Wiebeet al. (2019) found that circular economy/bioeconomy provides more opportunities for high-skilled and female workers.

Instead, El Wali et al. (2021) found that circular model fails to promote gender equality.

5 Conclusions

The evidences of the present study, even though it is an initial study, are consistent with the research questions.

Female entrepreneurs as well as female directors or female employees plays a critical role in achieving sustainable economy and sustainable development, also in social and environmental dimensions (Al-Qahtani et al., 2022).

At the same time, the growth of the service sector, stimulated by the transition to a circular economy and bioeconomy, could provide more opportunities for female employment (Wiebe et al., 2019).

Limits

The study, also because in the initial phase, has limits both with regard to the bibliometric analysis and with regard to the systematic analysis of the documents.

The bibliometric analysis is conducted on a limited number of papers and to make the analysis more accurate it will be necessary to expand the bibliographic datasets.

The systematic analysis also requires further study also expanding the number of documents analyzed with the inclusion of "grey" literature such as policy and industry reports identified from websites and citing searcing.

Theoretical and Practical implication

The study highlights: 1) the role of women in promoting circular economy practices and in achieving the sustainable development goals set at both national (PNRR) and international levels; 2) the importance of move towards a more circular economy also for encouraging gender equality.

Digital technologies (such as artificial intelligence, blockchain, internet of things and cloud computing) can facilitate the transition to circular economy and bioeconomy and overcome obstacles that stand in the way of the large-scale deployment of green entrepreneurship (Barteková and Börkey, 2022).

Gap and future developments

Results of the study are useful to identify gaps in literature on the topic and direct the future studies for filling the gap. In this respect, the word "digitalisation" does not appear among most cited keywords and this could indicate the literature gap on the subject that has not adequately investigated the relationship between women-led firms, digitalization, and circular bioeconomy. At the same time, the words "circular bioeconomy" rarely appear together and this also indicates the need to explore both the topic of circular bioeconomy and the link between women-led firms and circular bioeconomy.

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The Impact of Strategic Knowledge Management in Lean Healthcare Organizations

Nicola Capolupo*

Dipartimento di Scienze Aziendali, Management & Information Systems, University of Salerno
Via Giovanni Paolo II, Fisciano

Emilia Romeo

Dipartimento di Scienze Aziendali, Management & Information Systems, University of Salerno
Via Giovanni Paolo II, Fisciano

Paola Adinolfi

Dipartimento di Scienze Aziendali, Management & Information Systems, University of Salerno
Via Giovanni Paolo II, Fisciano

Francesca Loia

Dipartimento Di Economia, Management E Diritto Dell'Impresa
Università degli Studi di Bari
Piazza Umberto I, Bari

* *Corresponding author*

Abstract

The healthcare industry faces various challenges, and Lean management and Six Sigma initiatives are gaining attention for their ability to improve performance by reducing defects, waiting time, and costs while increasing patient satisfaction. Strategic Knowledge Management (SKM) is essential for the success of Lean and Six Sigma initiatives in healthcare organizations. SKM focuses on arranging knowledge resources and competencies to bridge the knowledge gap between required and existing know-how in the organization, enhancing people's skills and assets. This study aims to explore the relationship between Lean management and SKM approach to knowledge management in healthcare organizations. The study uses regression analysis to investigate the role of SKM in achieving Organizational Performance Improvement. The findings enrich the debate in the literature on the use of a strategic knowledge-based approach to continuous

improvement and provide a comprehensive framework for healthcare facility managers to promote knowledge sharing as a core asset within organizations.

Keywords – Healthcare, Organizational Performance, Lean Six Sigma, Strategic Knowledge Management

Paper type – Academic Research Paper

1 Introduction

Healthcare is a service industry that deals with complex tasks and challenges, and its responses often lie in employing new organizational models geared toward innovation, quality, cost reduction, and achieving patient satisfaction. Among them, Lean management and Six Sigma initiatives are receiving particular attention for their systemic approach to criticalities and their capabilities to enable the organization to produce knowledge (Vlachos et al., 2019), value-in-use, and acquire a culture of continuous improvement (Antony et al., 2019). The literature supports the idea that integrating the Lean and Six Sigma approaches in Healthcare Organizations leads to improved performance by increasing patient care toward satisfaction and loyalty (Ahmed, 2019; Ahmed et al., 2019). Both the Lean and Six Sigma methods ensure the performance of the healthcare organization by reducing defects and variations, waiting time and costs, and improving service delivery. Furthermore, Lean and Six Sigma techniques are likely to generate a significant change in the way health professionals conceive their organizational life, to innovate health services by acting in an unprecedented and proactive way.

Nevertheless, to produce significant effects that last over time and, conversely, do not fail (Rosa et al., 2021), these implementations should be considered not as individual initiatives but as a strategic approach that is part of organizational culture. Uncoincidentally, failures occur when organizations do not foster a strategic vision in their processes (Marolla et al., 2021).

In this sense, Strategic Knowledge Management (SKM) acts as a key player in ensuring Lean and Six Sigma success in organizations (Aramoon et al., 2020) as well as in achieving a consistent improvement in performance. Strategic Knowledge Management is conceived as the field of Knowledge Management, which mainly refers to the activities embodied in the organization to achieve, implement, and distribute knowledge for strategy formulation and support

decision-making (Cabrilo & Dams, 2018). It constitutes a comprehensive method that the organization uses to arrange its knowledge resources and competencies according to the intellectual needs of the strategy. Inter-alia helps bridge the knowledge gap between the required and existing know-how in the organization and enhances people's skills and assets (Al-Tit et al., 2022). SKM has a special focus on HRM since manpower is the greatest and most precious asset of the organization and assumes a core value in both Lean and Six Sigma initiatives. Hence, SKM refers to an organization's structures and processes that help improve organizational performance.

Therefore, this study aims to explore the relationship between the implementation of Lean Management and the SKM approach to knowledge management. To this end, a sample of Italian healthcare professionals was employed to investigate, through regression analysis, the role of SKM in leading Lean and Six Sigma initiatives to achieve Organizational Performance Improvement in healthcare organizations. The effort of this study is, on the one hand, to enrich the debate in the literature on the use of a strategic knowledge-based approach to continuous improvement and organizational change. On the other hand, it provides a comprehensive framework for healthcare facility managers regarding the importance of promoting knowledge sharing as a core asset within organizations.

2 Theoretical background

Strategic knowledge management (SKM) refers to the overall strategy, aims, and objectives of an organization. It refers to the procedures and infrastructure that companies use to acquire, develop, and exchange information to formulate strategies and make strategic choices (Ferreira et al., 2020).

In healthcare, transferring and employing knowledge across organizations enables professionals to make better-informed decisions and avoid costly mistakes. Furthermore, SKM may promote cooperation and collaboration among healthcare practitioners by increasing information-sharing and applying best practices (Illanes, 2019). To Rego et al. (2023), SKM may increase the efficiency and efficacy of healthcare delivery. Scholars have stressed the need to cultivate a culture of continuous improvement and foster information exchange among healthcare practitioners and organizations (Alrhabbi et al., 2022). This may be achieved through training for healthcare staff as well as employing knowledge

management innovations such as electronic medical records and databases that enhance systematic knowledge dissemination aimed at improving patient care, process efficiency, and cost savings (Abbate et al., 2022). To this end, a variety of quality management techniques are being employed in healthcare, particularly Lean Management and Lean Six Sigma.

Lean Management is a streamlined method that increases organizational income, decreases costs, and enhances patient satisfaction by eliminating inefficient processes (Rizan et al., 2020). The Lean method is simpler, more efficient, and cost-effective, and it offers users appropriate service quality. This technique focuses on improving the process speed by decreasing lead time and waste, as well as providing a way to evaluate and reduce costs and increase process efficiency. .

Lean Six Sigma, on the other hand, is a data-driven process improvement strategy that blends statistical analysis with lean principles to reduce defects and process variations (Black & Revere, 2006). LSS's aim is to improve process quality and efficiency, while lowering costs and increasing customer satisfaction.

Therefore, the connection between LSS implementation and Organizational Performance Improvement is evident but only if all organizational levels are involved in broad-based change, as individual initiatives may not be sufficient. Individual LSS initiatives within an organization have no significant effect on Organizational Performance Improvement (Aramoon et al., 2020). By contrast, the implementation of LSS initiatives can lead to improved organizational performance when a strategic approach to knowledge sharing is employed within the organization. In other words, once institutionalized and supported by SKM processes, LSS projects can become best practices that enhance organizational efficacy and contribute to Organizational Performance Improvement. In fact, the literature supports both the positive effect of LSS on SKM (Rejikumar et al., 2020) and Organizational Performance Improvement (Al Ahbabi et al., 2019). Accordingly, this article discusses the role of SKM in relation to LSS and Organizational Performance Improvement.

3 Methodology and results

This study included personnel from public healthcare institutions (physicians, nurses, administrative employees, hospital pharmacists, and health and social workers) in the Puglia Region (Italy). The data for this study were collected using

Google Forms. A total of 186 responses were provided. Incomplete questions were not identified. The sample comprised a small majority of females (56%). Less than half of the respondents had professional experience of 1-5 years (10,92%) and 6-10 years (28,71%), whereas the vast majority (60,3%) were in the highly advanced professional age group.

For Organizational Performance Improvement, six items from Masa'deh et al. (2016), on a Likert scale of 1-5, were employed to find consistency (CR= 0.9; AVE=0.7; Cronbach's alpha = 0.8). The Lean Six Sigma scale, adapted from Ahmed et al. (2018a), comprises nine items (CR= 0.7, AVE= 0.5, Cronbach's alpha = 0.7). To measure Strategic Knowledge Management, López-Nicolás and Meroño-Cerdán 's(2011) items (n = 8) were adapted ((CR= 0.8; AVE=0.6; Cronbach's alpha = 0.7).

SPSS AMOS-24 software was used to perform structural equation modeling (SEM). The results are summarized in Table 1 and show that LSS has no significant effect on organizational performance. Nevertheless a statistically significant and positive direct effect was found between LSS and SKM, indicating a proven relationship between Lean Management methodologies and Strategic Knowledge Management. Additionally, a statistically significant and highly positive relationship was found between SKM and Organizational Performance Improvement, confirming that organizational-level information sharing positively affects healthcare organization performance.

Furthermore, the analysis shows a positive mediation effect of Strategic Knowledge Management on the relationship between Lean Six-Sigma and Organizational Performance Improvement. The data show that the beta coefficient for the relationship between SKM and the LSS-OPI route is 0.459, with a standard deviation of 0.05, lower limit of 0.025, and upper bound of 0.087. This suggests that the relationship is statistically significant, and that SKM plays a critical role in enhancing performance through the LSS approach.

Table 1. Regression analysis results

Effect	Corrected Bootstrap (95% confidence interval)	Path	β-value	S.D.
Direct		LSS->OPI	-0.012	0.8
Direct		LSS->SKM	0.320**	0.05
Direct		SKM->OPI	0.678**	0.1
Indirect (Mediation)	Lower 0.025 Upper 0.087	LSS->SKM->OPI	0.459**	0.05

4 Discussions and conclusions

This study confirms the importance of Strategic Knowledge Management (SKM) in enhancing the potential of Lean Six Sigma (LSS) to enhance Organizational Performance Improvement in healthcare. The study finds that there is no statistically significant direct effect between LSS and OPI. As suggested by Sony et al. (2019), one reason LSS projects may fail is that the available knowledge is of poor quality, as LSS relies on accurate data for process improvement. Inaccurate or unreliable data can lead to worthless results and fail to produce substantial improvements.

Nevertheless, the study confirms that there is a direct positive effect between LSS and SKM, and between SKM and OPI. Consistent with Rozo-Rojas et al. (2019), this study emphasizes the importance of sharing information and data for successful LSS implementation, and suggests that healthcare organizations should still share knowledge over time to spread the effect of change-based methodologies. Strategic Knowledge Management also positively affects Organizational Performance Improvement, as Aramoon et al. (2020) point out, observing that healthcare managers may improve organizational performance and patient service delivery through a knowledge exchange system that involves different functional units and teams. According to Zaim et al. (2019), knowledge sharing is an essential organizational activity that can enhance organizational knowledge capabilities and ultimately lead to better quality and performance.

Furthermore, SKM acts as a mediator between the LSS and OPI. A strategic approach to knowledge sharing involving SKM is imperative for improving the performance of healthcare organizations. Lean Six Sigma (LSS) initiatives can improve organizational performance in healthcare by leveraging strategic-level knowledge sharing and institutionalizing practices at the organizational level. This

can help overcome limitations related to scope and data shortages, which may otherwise hinder the success of such initiatives.

The integration of knowledge management into the deployment of Lean Six Sigma in healthcare organizations provides several opportunities. First, it improves the efficiency of the LSS implementation process by making critical information available to all the stakeholders. This reduces the time and resources spent on information searches, and allows teams to focus on refining systems and providing high-quality patient care. Second, knowledge management ensures that LSS initiatives are built on accurate and up-to-date data, which minimizes the possibility of failures, and guarantees that changes are made in the most effective and efficient manner. Finally, incorporating knowledge management into LSS ensures that the benefits of LSS initiatives persist. By collecting and sharing the lessons learned from each project, organizations can continue to build on their achievements and prevent duplication and waste.

This study emphasizes the compelling need for a holistic perspective that leverages Strategic Knowledge Management to enhance organizational performance through Lean Six Sigma. It can contribute to the ongoing debate in the literature on knowledge and organizational performance in healthcare, which involves many complex interactions.

Overall, this study aims to enhance our understanding of how LSS initiatives can be implemented effectively in healthcare settings to achieve optimal performance outcomes.

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Digital Transformation in the Fashion Industry: Metaverse as an Additional Business Platform or a New Innovative Stakeholder Interaction Model

Michelle Grillo*

eCampus University
via Isimbardi, 10 Novedrate (Co)

Sabrina Bonomi

Department of Law
eCampus University
via Isimbardi, 10 Novedrate (Co)

* *Corresponding author*

Abstract

Digital transformation changed the way of doing business. In recent years, the fashion industry has undergone a profound change. The climate of uncertainty, the challenges related to the VUCA context, and ethical and environmental issues necessitated implementing digital strategies and increasing sustainability and social responsibility oriented. Creating new and solid links with online Millennials communities sensitive to sustainability is also essential. The priorities are less advertising bombardment to induce purchase and more conversations to build trust, setting up environments of interactions (Noci, 2011). The year 2022 has been marked by the profound participation of many fashion houses, luxury but also fast fashion, in Metaverse, that have not only made agreements to be present within it but have also contributed to its development. They have implemented a presence in the Metaverse as part of their marketing strategies not to lose a competitive advantage. At the same time, new and exciting start-ups have sprung up to a new and flourishing area of business.
This paper aims to understand whether the Metaverse in the fashion industry can be regarded as a new and additional e-commerce platform or if it can be considered a new sustainable business model based on innovative interactions between its stakeholders.

Keywords – Metaverse, digital fashion, new technologies, knowledge

Paper type – Academic Research Paper

1 Introduction

Digital transformation has dramatically changed the way we do business. The climate of uncertainty caused by the Covid 19 pandemic, the challenges related to environments characterized by increasing levels of volatility, complexity, and ambiguity, as well as ethical and environmental issues, have led to implementing digital strategies that have developed in different directions and ways.

In this context, an increasing sustainability and socially responsible approach is needed with the advantage of delivering significant benefits to businesses, society, and the environment (Camilleri, 2017) and creating new and solid links with online communities, especially of Millennials and GenZ, whose perception around luxury has changed in the direction of an ever-greater awareness of sustainability. (Giachino, et al. 2021).

Therefore, it is necessary to acquire new knowledge and skills and a new "digital" entrepreneurship (Nambisan, 2017). Entrepreneurship research has always investigated the relationship with digital technologies to understand how they can influence entrepreneurial initiatives (Weking et al., 2023).

Looking at the link between fashion and technology, it is possible to see distant roots; the realization of fabrics and clothes gave rise to the first industrial revolution in the eighteenth century in Europe. "*It was precisely the textile industrial reproduction that made fashion possible as a form of technical reproducibility*" (Calefato, 2016, p102).

Analyzing fashion, its changes, and evolutions means understanding the future: "*Each season carries within itself in the latest creations some secret signal of future things. Those who learn to read them could not only know in advance something about the new artistic currents but also the new codes, wars, and revolutions*" (Benjamin, 2010, pp 68).

In this combination of technology, entrepreneurship, and future, not analyzed as a whole, this article is developed that aims to understand how digital fashion within the "Metaverse" platforms can constitute not only a new distribution channel but an element of vision and change in the way of interacting between the different stakeholders of the company, especially between users and entrepreneurs.

Specifically, the purpose of the paper is to answer the following research question, whether the metaverse can be considered a new and additional business platform in the fashion sector or whether it is to be considered an

innovative way for companies to communicate with their stakeholders, primarily consumers.

2 Theoretical backgrounds

The metaverse is a new concept that exploded following the rebranding of Facebook in Meta (Rospigliosi, 2021; Lopez-Diez, 2021), as can be understood through the Google trends indices, in which the term "metaverse" in the world reached 100 only in January 2022, while the search for the time in previous years is almost zero.[1]

According to Matthew Ball, the metaverse can be defined as "a network of maximum scalability and interoperability of 3D virtual worlds redirected in real-time, which can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence within them, and which guarantee data continuity, related to identity, history, rights, objects, communication, and payments" (Ball, 2022, p.55).

The metaverse has also aroused interest for business purposes; the integration of various forms of technology, such as blockchain, artificial intelligence, machine learning, NFT, could represent an advantageous business model (Periyasami, Periyasamy, 2022), considering that forecasts estimate that 25% of people will spend at least one hour a day in the metaverse by 2026 (Gartner, 2022).

In Italy, Cosenza (2022) created an observatory with an organized mapping of the metaverses existing so far, considering the following parameters: the three-dimensionality of the environments; the shareability of spaces simultaneously by several users; sociality; with identity based on freely movable avatars and with the ability to interact with others and with the environment.

The business opportunities are linked to the purchase of virtual shops and immersive e-commerce, of land and digital real estate, of art, clothes, and accessories in Non-Fungible Token (NFT) wearable by avatars, but also all 'use of classrooms and virtual offices, to business opportunities regarding marketing related to the sponsorship of spaces within the metaverse (billboards, streets, places); but also to participate in social and virtual events such as concerts, meetings, and fairs, to organize events for one's community (Grillo, 2022). The metaverse is expected to become a trillion-dollar market within a decade (Weking

[1] *Data available on https://trends.google.it/trends/explore?date=all&q=metaverse*

et al., 2023). Specifically, McKinsey says it has the potential to generate up to $5 trillion in value by 2030 (Elmasry et al., 2022).

The growth of interest around the metaverse in the fashion sector has also led to increased brands. In fact, for the user, entering a metaverse means creating their avatar and exploring digital environments by connecting with other users, creating a more immersive high-intensity experience (McLuhan, 2015). 94% of users in 2022 customized their avatars. Many fashion brands have seized an economic opportunity in this and have implemented various strategies to enter the metaverse. The "fashion in the metaverse" question is still embryonic but represents an up-and-coming field of investigation (Grillo and Bonomi, 2022).

Breiter and Siegfried (2022) first attempted to explore consumer expectations and attitudes in the fashion industry in the metaverse. According to their study, consumers must still be ready for the metaverse. However, some are willing to pay to purchase digital clothes and accessories.

Jang and Kim (2023) investigated the effects of such avatar customization on game metaverse platforms in fashion education processes. The possibilities related to customization and immersive interaction are joined by more practical reasons associated with the possibility of working within a forum that can influence the pre-existing business models in the fashion sector, allowing companies to sell, ship and collect payments safely, engaging customers and improving sustainability and reducing waste (Periyasami and Periyasamy, 2022). Engaging customers in the metaverse through immersive experiences is a crucial data collection element. One example is the 2000s-inspired Y2K aesthetic. Mainly spread by the TikTok social platform, it invaded the Roblox marketplaces to be launched on the high fashion catwalks (Parkinson, 2021).

The theme of artificial intelligence in fashion in the metaverse is confirmed by the study by Mu et al. (2023), who explores how fashion smarts help fashion houses create products in line with the styles emerging from their communities. Compared to real-world data, fashion intelligence applications in the metaverse can generate accurate predictions and help retailers characterize market trends.

3 Methodology

This study is still exploratory and a part of more extensive work investigating the link between fashion and the metaverse.

To try to answer the research question, the activities carried out by fashion houses on different platforms were observed with a qualitative methodology, because it was considered more appropriate for an exploratory study. An ethnographic analysis was carried out, with a participatory observation (Corbetta, 2014) on the metaverse platforms of Roblox, Zepeto, The Sandbox, Minecraft, Decentraland, and among online communities. The media were chosen based on the ease of access through PC or smartphone, and the observations were organized and encoded in a file from which it was possible to elaborate a map of the brands in the metaverse.

Subsequently, we verified which fashion brands carry out activities for the world giving life to a native market, and which instead use the metaverse to support the sale of IRL products.

3.1 Data Collection and Analysis

From the participatory observation of the metaverse platforms, a map has been developed that offers an initial overview of the brands present.

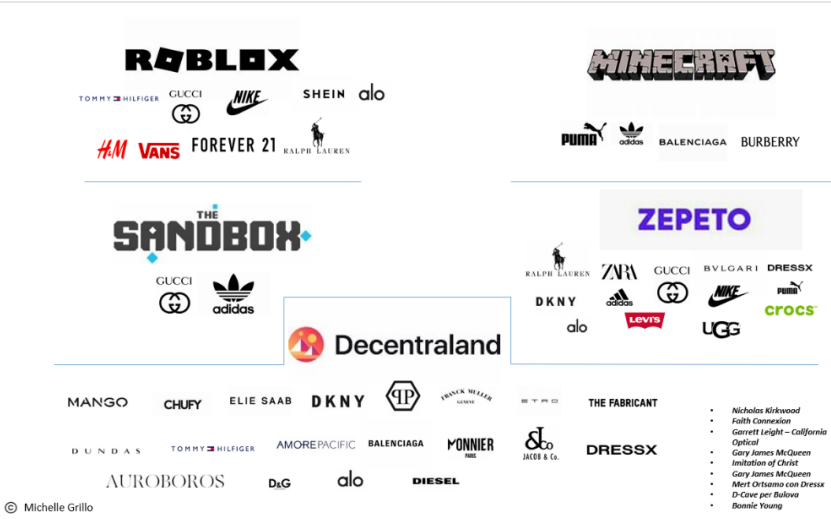

Fig 1 – Mapping fashion houses in the metaverse (Source: Authors' elaboration)

We analyzed twelve brands: Adidas, Bulgari, Burberry, Dolce & Gabbana, Forever 21, Gucci, H&M, Nike, Tommy Hilfiger, Prada, Ralph Lauren, and Shein.

Observing the positioning on the metaverse platforms of fashion companies, three business models have been identified as follows: brands present in the

metaverse for the sale of physical products (A1); brands present in the metaverse to sell digital products for avatars (A2), and luxury digital twins or exclusive products in NFT (A3).

Tab 1 - Summary of observed business models (Source: Authors' elaboration)

A1 Brands in the metaverse to sell physical products.	H&M, Lacoste, Burberry.
A2 Brand in the metaverse to sell digital products for avatars	Adidas, Gucci, Shein, Nike, Ralph Lauren, Prada, Forever 21, Tommy Hilfiger, Bulgari.
A3 Brands in the metaverse to sell luxury digital twins or exclusive products in NFT.	Dolce & Gabbana, Bulgari, Prada, Gucci.

Brands in the metaverse A1 stay for selling products in IRL. According to this model, platforms lend themselves to being an essential narrative territory (Camacho, 2022) to improve awareness around the brand while maintaining a touchpoint within a digital space that could prove promising. This is the case, for example, of Lacoste, which created a virtual store that offers an immersive experience for buying products in IRL.[1]

The collaboration between Burberry and Minecraft includes the game "Burberry: Freedom to go beyond" and a capsule collection in the real world inspired by the style of the play. Burberry also offers the opportunity for avatars wearing the brand's garments to complete a series of challenges, such as a maze covered with Burberry's signature plaid pattern, in four worlds designed in collaboration with Minecraft Blockception map creators. [2]The gaming experience is aimed at selling Trench Coats, logo sweatshirts, hoodies, hats and scarves from Burberry's website, in an operation that the brand has described as a bridge between the digital and physical worlds.[3]

H&M has instead abandoned the initial project of the shop in the metaverse of Ceek (Özkaynar, 2022) launching at the end of 2022 Loooptopia on Roblox, a gaming experience in which players foul-mouthed elements that allow them to dress up avatars and participate in fashion shows, however without offering an experience of buying digital clothes or accessories[4]. The game is part of a wider project of recycling clothes and discarded fabrics in a green-friendly perspective that the Swedish company has decided to adopt. Each store of the chain is

1 https://www.lacoste.com/gb/virtual-store.html
2 https://us.burberry.com/c/collaborations/minecraft-burberry-partnership/
3 https://it.burberry.com/c/collaborazioni/collaborazione-burberry-minecraft/
4 https://www.roblox.com/games/11700520283/Loooptopia

equipped with containers in which it is possible to give the fabrics. The Stuttgart store has a "Looop" - hence the name of the game - in which materials are inserted to be shredded and spun. [1] The Swedish company then launched an IRL collection for the fall winter 2022 season inspired by the aesthetics of the metaverse and seven a series of ARFs that can be used from the H&M App and created in collaboration with the Institute of Digital Fashion in London.

Model A2 aggregates the brands in the metaverse for the sale of digital products intended for avatars. Ralph Lauren offers a prime example of collaborating with several metaverse platforms (Roblox and Zepeto) to build a narrative universe and sell digital clothes and accessories. The American brand created an immersive Christmas-themed gaming experience on Roblox that allowed players to explore the Ralph Lauren universe in a limited time of two weeks and purchase an exclusive collection. Even if the game is idle, you can still purchase digital clothes and accessories on the marketplace[2]. Ralph Lauren is also present on Zepeto (Seon, et al., 2022) with an immersive experience set in New York where you can open and buy digital objects.

Tommy Hilfinger is present on Roblox with an immersive gaming experience in a futuristic New York where you can watch fashion shows and unlock branded digital accessories[3]; the shopping experience continues in the Roblox shopping area where there are clothes and accessories to customize avatars. The brand is also present on Decentraland's Metaverse platform as a partner of the second edition of Metaverse Fashion Week[4].

Adidas focuses on multichannel positioning itself on different metaverse platforms, offering immersive experiences on Zepeto, Minecraft and the Sandbox. It is also present on Decentraland as a partner of the MVFW. It has created a collection of digital clothes in NFT called Virtual Gear acquistabiland on the Open Sea Marketplace[5] in Ethereum cryptocurrencies[6]. Nike replicates Adidas' multi-channel approach by targeting the metaverses of Roblox and Zepeto, creating immersive gaming experiences to play and buy clothing and accessories for their

1 https://www.youtube.com/watch?v=CkbggB0IIAs
2 https://www.roblox.com/users/2838285613/profile
3 https://www.roblox.com/games/9129288160/Tommy-Play
4 https://mvfw.org/
5 https://www.adidas.com/metaverse
6 https://opensea.io/collection/adidas-virtual-gear

avatars. Nikeland on Roblox was created in September of 2021 and the last update was on March 16, 2023,[1].

The Forever 21 brand is present on Roblox with the immersive universe Shop City, a game in which you can build your personalized store, create your style with exclusive clothing and make-up[2]. On the Roblox marketplace you can buy digital clothes whose success has led the Los Angeles company to create a physical collection inspired by the digital one. An interesting case is the branded digital cap that can be purchased at 60 Robux on Roblox and has become an inevitable accessory on the Forever 21 ecommerce site at the price of 14 euros[3].

Gucci is among the most innovative brands in Web 3.0. In 2021 she joined Roblox, creating the virtual world Gucci Town, a space [4] minigames, a café and a shopping space where players can buy Gucci virtual equipment for avatars to wear. In 2022 it purchased the virtual lands on The Sandbox giving way to the new metaverse project "Vault", a space where from 27 October to 9 November 2022 it was possible to visit the concept store and live game experiences where you can win and perform missions to unlock a lottery and win land on TheSandbox or NFT[5]. On Zepeto is present with Gucci Garden[6], even here, you can play and unlock elements to dress your avatar.

The fast fashion brand Shein is present on Roblox in collaboration with the Swedish fintech Klana. The immersive universe "Shein x Klarna Wonderland", presents itself as an expansion in the digital environment of those same experiences lived in the physical environment with the opening of [7]pop-up stores that Shein has implemented, in association with Klarna, in the cities of London, Paris and Barcelona. A showroom model [8] without in-store goods in which to live experiences, such as live music, free offer of ice cream, coffee or hot chocolate; Shein's Wonderland on Roblox recreate same physical experiences with the possibility of accessing the SheinForAll building, the Shein store where you can buy clothes and accessories for our avatar.

The A3 model aggregates brands whose presence in the metaverse represents an opportunity to create and sell exclusive luxury digital products or twins of

1 https://www.roblox.com/games/7462526249/NIKELAND
2 https://www.roblox.com/games/8254336243/Forever-21-Shop-City
3 https://www.forever21.com/us/shop/catalog/category/f21/promo_roblox_collection
4 https://www.roblox.com/games/7830918930/Gucci-Town-UPDATE
5 https://www.sandbox.game/en/blog/gucci-vault-is-opening-in-the-sandbox/3266/
6 https://www.gucci.com/it/it/st/stories/inspirations-and-codes/article/zepeto-x-gucci
7 https://www.roblox.com/games/10956766913/SHEIN-x-Klarna-Wonderland
8 https://www.youtube.com/watch?v=H9J8hqZCZDc

physical products in NFT (Periyasami and Periyasami, 2022). NFTs lend themselves to luxury due to their exclusivity, helping brands stay relevant (Kirjavainen, 2022). Anexample is Dolce & Gabbana which with the NFT collection Genesis (Segura, 2022) showed the powerful combination of NFT, tangible fashion and the luxury brand experience linked to the purchase of NFT. Each NFT metaverse purchased was matched with an original signed sketch, a private tour of the atelier and an exclusive invitation to Dolce and Gabbana's IRL show (Kirjavainen, 2022). The entire collection was auctioned for the sum of 1885.73 ETH, equal to about six million dollars (Crescenti, 2021).

The Zeta generation is increasingly involved in the creative and development process of digital products; they are consumers of products but also co-creators of garments (Särmäkari and Vänskä, 2020). An example is The Fabricant (Särmäkari, 2021), which has created a Studio platform where users can create digital clothing. Nike launched SWOOSH, a web-enabled platform3 that supports athletes and the future of sport by creating a new community and inclusive digital experience, and a hub for Nike virtual creations.[12]

In 2021, in collaboration with the director and digital artist Refik Anadol, Bulgari created a multisensory experience of the iconic snake in Milan with the support of artificial intelligence, narrating and enhancing its nature and transformation. The exhibition Serpenti Metamorphosis has become an independent NFT (Castriota, 2022).[3] Prada has launched the Prada Crypted space, a space dedicated to NFTs on Prada.com that connects fashion, art and Web3 and where every first Thursday of the month a limited-edition physical object and its digital twin in NFT is released. The link between art and fashion is also realized in Gucci with the Vault project[4], a space to buy artworks in NFT made by different artists.

4 Discussion and conclusions

This work aimed to understand what the role of the metaverse could be in the fashion industry, whether it could represent an additional distribution platform or rather a new way. to communicate with its stakeholders, especially customers.

1 https://www.thefabricant.com/
2 (https://about.nike.com/en/newsroom/releases/nike-launches-swoosh-a-new-digital-community-and-experience)
3 https://www.prada.com/prada-crypted/
4 https://vaultartspace.gucci.com/gallery/room

The. After an analysis of the existing literature, an exploratory study tried to fill the gap found by reviewing the brands that make exclusive products for the metaverse giving life to a native market and those that use the metaverse as a platform to support sales in IRL.

Since the processing of the information collected, three different ways of participating in the metaverse have been classified. For some brands, the metaverse is declined as an interaction tool in which they build their reputation. At the same time, through immersive or gaming experiences, they ask for feedback from consumers, and finalize the sale of physical products. The second model includes brands that have created a new business area with the sale of digital products. The same digital products at the same time can activate reverse processes, orienting the realization of physical twins, with cases in which the success of digital products has inspired the physical clothing collection (Cimermanaite, 2022), highlighting another fundamental aspect concerning the presence of fashion houses in the metaverse, the function of testing collections before the production of physical collections (Särmäkari andVänskä, 2020), but also to intercept styles and trends within online communities according to a grassroots process (Jenkins, 2014). Thanks to the data collection achievable with Fashion Intelligence (Mu et al, 2023), it is possible, in fact, to extract important data to help designers create products in line with the preferences that emerge in online communities.

In this sense, it is possibleto hypothesize that the Metaverse is part of the broader framework of a change in the way of interacting and expressing one's identity, which can be realized thanks to the purchase of clothes and digital accessories on the metaverse platforms Zepeto, Minecraft and Roblox; the demand for virtual fashion in fact grows, as Gen Z spends more and more time in immersive social spaces socializing, creating and expressing themselves (Parkinson's. , 2021)

The third model examined the luxury brands Dolce&Gabbana, Bulgari and Prada that intend to maintain their exclusivity with the sale of NFT (Simmel 2005; Veblen 2017) in the digital market opening up to the new opportunities that the new native luxury market offers through the sale of exclusive NFT clothes and which shows important margins for growth and maturation (White et al., 2022). NFTs allow you to perceive belonging to a group thanks to a model that gives life to an ecosystem that creates a narrative around the released digital object (Kaczynski, 2021), with a roadmap that offers buyers access to the product,

exclusive activities and experiences - the case of the Genesis collection by Dolce & Gabbana has been reported - giving life to real communities, further strengthening the sense of belonging and making consumption more desirable (Kirjavainer, 2022).

The main implication of the study is that overall, the three business models analyzed have important common elements. First of all, the Metaverse lends itself to being an important narrative territory (Camacho, 2022) for businesses and consumers and of new interaction between stakeholders, capable of giving life to a new entrepreneurship to prepareand companies for new challenges in the fashion and luxury sector (Alexander, and Bellandi, 2022) . Secondly, it is a space of interaction to create value within online communities, through gaming experiences; sale of NFT; gaming experiences related to selling digital clothes for avatars.

Storytelling and interaction are key elements of metaverse platforms capable of preparing companies for new consumers: GenZers are increasingly involved in the creative process and development of digital products, as co-creators of garments. Collaborative fashion, offering the possibility of living a participatory experience, is also an important tool for collecting data on styles and trends (Mu, 2023) reinforcing the hypothesis that the metaverse represents a new interaction model.

The sale of NFT is geared towards strengthening the community around the brand; the creation of immersive worlds in which companies can spread their values while offering users an experience in which to play and buy digital objects; The co-creation of digital clothes on metaverse platforms or within the media of digital fashion houses, reveal that the metaverse is much more than a shopping space for fashion but a territory within which actors and online communities give life to a new and lively model of interaction, a model that necessarily requires new knowledge and new skills to give life to the business of the future.

The main limitations of the study lie in the exploratory nature itself, but we are convinced that it can be a stimulus to continue to deepen the emerged strands, to develop ever-new knowledge of fashion enterprises to bring to life the business of the future.

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Complex Systems Approach to Adaptable and Sustainable Heritage Renovation and Valorization: Integrate, Optimize, Build in Sensitive Areas in Sardinia

Fernanda Speciale*

Department of Architecture, Built Environment and Construction Engineering
Politecnico di Milano
Piazza Leonardo da Vinci, 32 - Milano

Giovanni Mandelli

Department of Architecture, Built Environment and Construction Engineering
Politecnico di Milano
Piazza Leonardo da Vinci, 32 - Milano

Francesco Pittau

Department of Architecture, Built Environment and Construction Engineering
Politecnico di Milano
Piazza Leonardo da Vinci, 32 - Milano

Laura Elisabetta Malighetti

Department of Architecture, Built Environment and Construction Engineering
Politecnico di Milano
Piazza Leonardo da Vinci, 32 - Milano

* *Corresponding author*

Abstract

The proposal discusses methods and techniques that reduce the environmental impact of buildings over the lifecycle with the objectives of adaptive reuse of cultural heritage buildings. To achieve this goal, an integrated approach to design is used, which involves the analysis of questions, strategies, and actions in a complex system applied to a case

study located in Sardinia, Italy. This place is the military battery of Capo d'Orso, once the avant-garde of military technology, today abandoned fossil trapped in millenary granites. Awakening these places, no longer as spaces dedicated to war, but as places full of history and open to new futures is essential. The new function, resulting from careful analysis of the heritage and the surrounding context, required the integration of new additional volumes. Three founding actions guided the project: Integrate, Optimize, and Build. The restoration project presented in the paper was shaped by crucial matters that cannot be overlooked, including energy and water saving, seamless integration between new and existing structures, the economic feasibility of construction, and efficient utilization of resources. These were the fundamental aspects that formed the backbone of the project.
This paper describes in particular the process of integration and optimization of the structure of an added volume necessary for the re-functionalization of the area. The addition is located on top of the underlying historical vaults of pre-existence. Given the great testimonial value of the historic vaults, the design intention was to preserve and protect them. The work describes a multi-objective optimization approach which had evaluated different design alternatives according to constraints given by the context and the pre-established objectives, in order to optimize the structural element as much as possible meeting all the requirements: structural efficiency, visual permeability, lightness, low environmental impact, the possibility of assembly on a particular site hard to access.
The study also shows methods to compare different technologies, configurations, and materials, starting from a structural scheme allowing the significant span and developing a finite element model for each configuration to evaluate structural performances.
Moreover, the design process made use of prefabricated technologies, dry solutions, and modularity to allow easier construction on a site hostile to traditional mechanisms. Eventually, the solution to the initial problem it's been able to achieve sustainability, comfort, and respect for the pre-existence without compromising on performance.

Keywords – Complex integrated systems, Multi-objective optimization, Historical built heritage valorization.

Paper type – Academic Research Paper

1 Introduction and background issues

Today the construction industry covers a crucial role in human well-being as well as in environmental impact. The subsequent manufacture, use, and disposal of buildings for shelter are conducted on a massive scale, causing significant consumption of natural resources and wastes. This demand makes the construction industry the largest consumer of resources globally (WEF, 2016). Furthermore, the building industry's greenhouse gas (GHG) emissions have risen steadily. The International Energy Agency noted that there was a 45% increase in building-related emissions since 1990 (IEA 2017). Furthermore, in 2020 a study

was conducted by the Weizmann Institute of Science on the material production of human activities compared to the overall natural biomass of the planet. It emerged that in the year 2020, the anthropogenic mass, which has recently doubled roughly every 20 years, surpassed the global living biomass, of which a large part is implied in buildings and infrastructures.

These facts make managing the environmental impacts of buildings critical to achieving a sustainable economy and limiting global human impact. The management of complex design systems has to face more and more ambitious standards of sustainability and quality of the buildings.

One of the sustainable strategies to be pursued is to transform a linear product supply chain into a circular one in order to capture the environmental benefits of adaptive reuse. In general, with Circular Economy, we mean production and consumption processes that require the minimum overall natural resource extraction and environmental impact by extending the use of materials and reducing the consumption and waste of both materials and energy. Just dealing with a refurbishment and reuse project of an abandoned area is already a first step of a circular building thinking approach. In this sense, the need is to recognize the existence of abandoned significant cultural heritage resources and their potential role in sustainable development, firstly in reversing land use spread. Moreover, taking into account the obsolescence of a built complex and its functions, it is fundamental to consider in the design process the entire life cycle of the building, from the choice of raw materials up to the end of life and the dismantling of it. In this sense, the choice of technologies that allow disassembly is crucial to guarantee a certain level of resilience for the building.

2 Complex integrated systems approach

With the increasing complexity of the construction sector and the ambitious environmental, social, and economic performances required by today's goals, it is important to orient the design focus not only on the results but also on the process to gain them. In this sense, methods capable of optimizing the resources used without compromising a project's comfort and quality levels are increasingly needed.

Literature and previous works demonstrate several environmental advantages of restoring existing buildings over new construction, especially for architecture related to the culture and identity of a place (Pittau et al., 2019). Restoring a

building is a process that goes beyond the simple technological and technical adaptation necessary to achieve better performance. Restoration is a recognition of an intrinsic value to architecture that deserves to be passed on. Nevertheless, this value can be considered historical, testimonial, economic, or technological value. Managing the complexity resulting from pre-existence is therefore a challenging process with no single best solution.

This research aims to investigate a methodology that can demonstrate how high-quality architectural construction can be compatible with sustainability. Throughout this process, sustainability will be approached from a holistic perspective, taking into account environmental, economic, and social factors. For those reasons, the work pays particular attention to the method and the working process, going to deepen fundamental issues to intervene in a delicate and sensitive context.

3 Methodology

3.1 Case study

The paper presents the integrated optimization process for the rehabilitation of the former military battery at Capo d'Orso. The Capo d'Orso military complex is one of the hundreds of military architectures in northern Sardinia, near Palau (SS). It allowed maritime control of the La Maddalena archipelago since 1887. One of the intrinsic characteristics of the Capo d'Orso area is its complexity, given by the architectural articulation, the location, the fragility of the context, and the precarious state of conservation. Knowing how to control these factors is complex, as to maintain a coherent thought with the project objectives during the entire duration of the design process.

The paper focuses on the construction of an addition, resulting from a larger restoration project, which aims to give a new function to the entire abandoned complex. The challenges coming from the addition are several. First of all, the project aims to ensure complete 360-degree visibility of the Maddalena archipelago as the only observation point within the area. The addition is assumed partly on the artificial embankment and partly to cover the historic vaults below, once used as ammunition storage. Given their great testimonial value, the design intention is to preserve the vaults, avoiding the addition's structure from bearing down on the vaults (Fig. 1). To ensure this, the addition's

new structure has to overcome 28 meters of span between the two embankments.

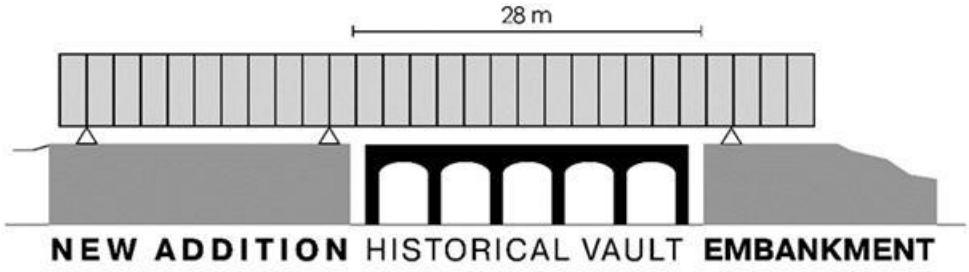


Figure 1 Schematic representation of the project addition on the historical vaults with the desired structural supports' position.

It is important to emphasize that the architectural constraints included two major limitations. On one hand, maintaining the maximum visual permeability of the addition as the only place where it is possible to enjoy the view. On the other hand, the impossibility of expanding the addition beyond the limits of the geometrical footprint, as no additional bodies could be provided. As a result, visually impactful structures or structures outside the footprint were to be excluded to support the addition. Moreover, the use of mostly low-impact or negative climate materials was a goal of the design process.

3.2 Multi-objective analysis

From these premises, it is clear the necessity to focus on several objectives simultaneously to find the design solution that satisfies them. Thus, the approach used involves a multi-objective process that allows different design alternatives to be evaluated according to the set objectives and constraints given by the context. The strategy aims to optimize the structural element as much as possible to simultaneously meet the requirements of structural efficiency, visual permeability, lightweight, low environmental impact, and construction site logistic (Fig. 2).



Figure 2 Design objectives taken into account.

To address the potential trade-off between the different objectives, we first proceeded by defining structural configurations capable of meeting the needs of the project. Each configuration was analyzed by considering different materials. Then each configuration was subjected to FEM, LCA, visual comfort, and cost analysis.

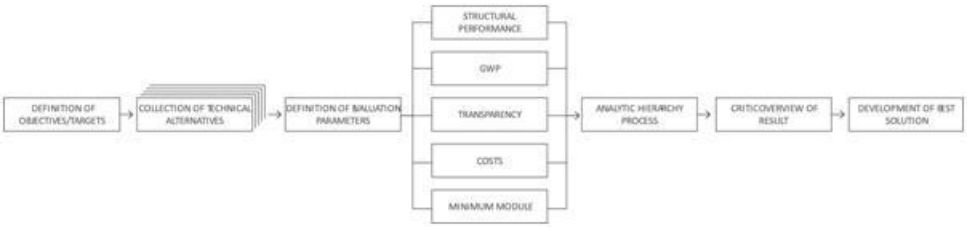


Figure 2 Multi-objective analysis steps.

One of the greatest difficulties when evaluating technical solutions is to ensure that they respect the architectural concept without distorting the design. Consequently, it is important to use an analytical evaluation tool that does not stop at evaluating only the structural performance. To meet these requirements, the Analytic Hierarchy Process (Uzun et al., 2021) was used, a multi-criteria evaluation process that allows different alternatives to be evaluated in relation to different criteria. The advantage of this method consists in being able to assign a weight to each criterion in order to consider the actual impact on the project. Thanks to this methodology, therefore, it is possible to evaluate the different alternatives analytically but without the risk of neglecting the actual importance that each parameter exerts on the design concept.

As previously mentioned, different structural configurations were evaluated, each of them realized with different materials. In order to make an optimal choice, it was important to define the parameters with which to evaluate each configuration. The definition of the evaluation parameters, therefore, was fundamental in defining the impact of the studied solution (Fig. 4).

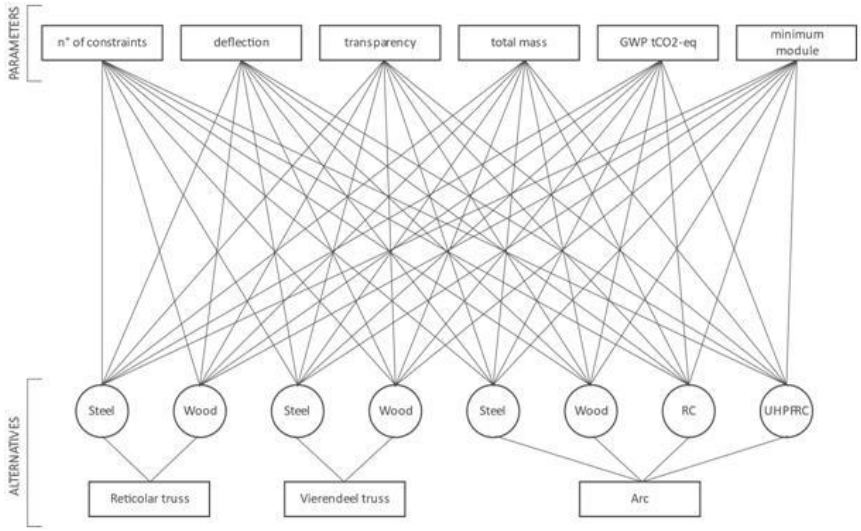


Figure 4 Different Alternatives and Correlations

The parameters used to classify the design solutions were:

- No. of supports on the bunkers, to limit the impact of the structure on the vaults below.
- Arrow, to evaluate the maximum arrow of the different systems from the preliminary stages.
- Transparency, to ensure visual permeability from the inside of the addition to the outside. Transparency is evaluated in percentage as the ratio of the transparent part to the whole wall surface.
- Structural mass, to evaluate the overall mass of the structure so as not to overstress the historical building and simplify the logistic of the construction site. Moreover, reducing the use of materials helps limit the environmental impact of the structure.
- Global Warming Potential (GWP), to identify and compare the impacts of different design solutions on global warming and energy resource use. For this purpose, the system boundaries for the analysis are from cradle to grave, considering the entire life cycle of the material, up to the end of life.
- Minimum module, given the difficulty of accessing the construction site located on the top of an impervious promontory, accessible only by a 4 meters width road. The minimum module is meant the smallest decomposable element of the structure.

- Cost, evaluating the cost of each available alternative. This parameter refers to the net cost of the raw material used to build the structure. Below the prices used:
    - Steel 700€/ton
    - Wood 600€/m^3
    - Ordinary concrete 180€/m^3
    - UHPFRC 1500€/m^3

4 Results

4.1 Structural systems

The first type of structure considered is the Neville reticular girder, which consists of horizontal and oblique rods connected to each other at the nodes by moment-locking hinges. The external forces in this scheme are applied at the nodes and only axial forces act in the rods, thus, being tensioned or compressed, but not inflected (Fig. 5).

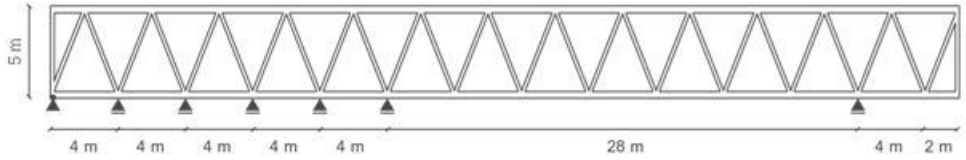


Figure 3 Neville reticular girder system

This solution was chosen as a starting point as the most commonly used to cover large spans, e.g. in the case of large infrastructures such as bridges, with limited weight and material usage. Another type analyzed is the Vierendeel beam, consisting of two continuous horizontal beams and a series of vertical uprights (Fig. 6).

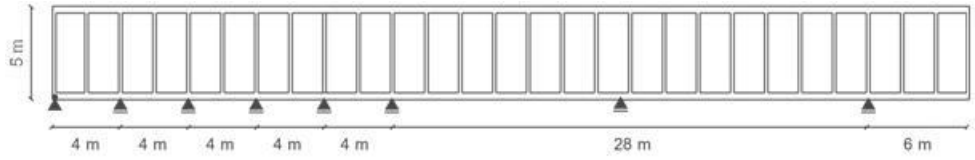


Figure 6 Vierendeel system.

In this vertical rod scheme, the constraints are rigid, represented by joints that can transmit the bending moment. In this case, the members are subjected not only to compressive and tensile stresses but also to bending ones. This solution is equally applied to cover large spans, although it requires a greater use of material than the previous one, resulting in an increase in the total weight of the structure.

During the first phase of comparing structural solutions, it emerged that each structural system fulfills a single parameter. In fact, although several structural alternatives were found to be structurally valuable, none of them satisfied all the objectives. Consequently, it was decided to change the approach and find another solution to be compared. Thus, a topological optimization problem was set up to achieve an efficient shape. Through this approach, we achieve the most efficient form given the boundary conditions, which was found in the arc (Section 4.2 Topological optimization).

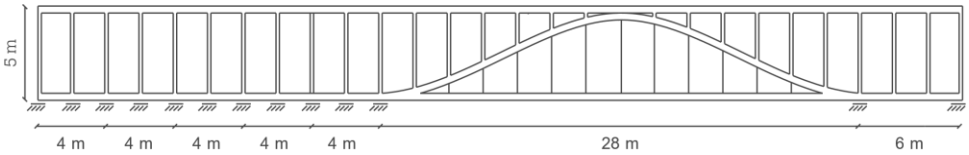


Figure 7 Arch system obtained by the topological optimization.

In order to compare the different technical solutions, we applied the Analytic Hierarchy Process. First, the values obtained were sized by dividing each result by the maximum value obtained in the case where the parameter positively affects the result (as in the case of transparency, where the larger the value, the better the technical solution). In the case where the smaller the value, the better the solution (as in the case of deflection), the individual data set was divided by the minimum of the values.

Table 1 Dimensional results.

	n° of constraints	Deflection [%]	Transparency [%]	Total mass [kg]	GWP tCO_{2eq}	Minimum module [m]	Cost [€]
Vierendeel - steel	1	0.07%	70%	134868	103605	8	94407
Vierendeel - wood	1	0.14%	56%	87483	45867	10	131225
Reticular - steel	0	0.04%	68%	131368	100917	8	91958
Reticular - wood	0	0.12%	56%	89000	25548	8	133500
Arch - steel	0	0.05%	71%	132901	102094	12	93031
Arch - wood	0	0.12%	52%	71339	37046	12	107009
Arch - RC	0	0.07%	67%	351046	52123	6	44822
Arch - UHPFRC	0	0.08%	69%	126590	45515	6	60763
Max	1	0.14%	71%	351046	103605	12	133500
Min	0	0.04%	52%	71339	25548	6	44822

At this point, the values of each parameter are compared in a range from 0 (worst) to 1 (best). As mentioned above, however, not all parameters are intended to be given equal importance. GWP, structural mass, and transparency were given more importance. To take this into account, a weight between 0 and 1 is assigned to each parameter and the sum of all weights constitutes one unit. Consequently, having 7 parameters in total, an equally distributed weight results in 0.1428 for each parameter. The determination of the score on the basis of which to draw up the ranking is made according to the following formula:

$$V_{ranking} = \sum V_{adim,i} \times W_i$$

$V_{ranking}$ = final score used to rank the solutions
$V_{adim,i}$ = dimensionless value of each parameter
W_i = weight value assigned to each parameter

In the first instance, an equal weight was assigned to each parameter in order to understand what the ranking is under standard conditions without considering the different design importance of the various parameters.

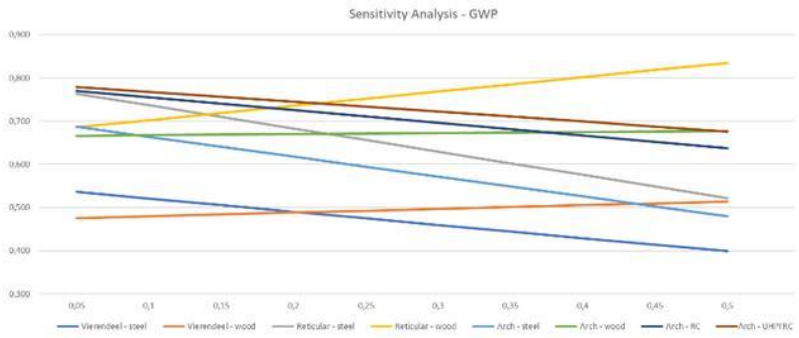
Table 2 Result - Dimensionless data with parameters' same weight.

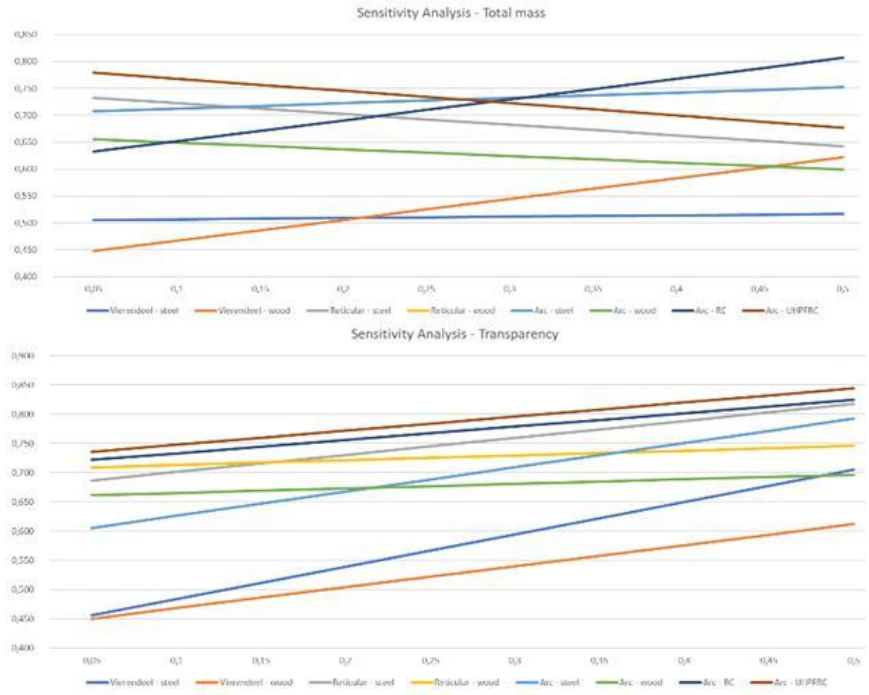
	n° of constraints	Deflection [%]	Transparency [%]	Total mass [kg]	GWP tCO_{2eq}	Minimum module [m]	Cost [€]	Rating
WEIGHT	0.143	0.143	0.143	0.143	0.143	0.143	0.143	
Vierendeel - steel	-	0.572	0.982	0.529	0.247	0.750	0.475	0.508
Vierendeel - wood	-	0.279	0.792	0.815	0.557	0.600	0.342	0.484
Reticular - steel	1	1.000	0.963	0.543	0.253	0.750	0.487	0.714
Reticular - wood	1	0.343	0.787	0.802	1.000	0.750	0.336	0.717
Arch - steel	1	0.740	1.000	0.537	0.250	0.500	0.482	0.644
Arch - wood	1	0.335	0.736	1.000	0.690	0.500	0.419	0.669
Arch - RC	1	0.569	0.939	0.203	0.490	1.000	1.000	0.743
Arch - UHPFRC	1	0.481	0.965	0.564	0.561	1.000	0.738	0.758

As can be seen from the ranking obtained, the arch solutions in RC and UHPFR together with the reticular girder solutions are those with the highest scores. This result is justified by the fact that they are solutions that overall perform well in most of the parameters. At this stage, we see that the UHPFRC arch is the best solution.

4.2 Sensitivity analysis

In order to assess the impact of each parameter on the final rating, a sensitivity analysis was carried out. The objective is to understand the evolution of the rating when one of the parameters varies. In particular, the evolution relative to GWP, transparency, and total mass was analyzed. By varying the parameter between 0.05 and 0.5 and keeping the other values constant, it is therefore possible to investigate the threshold beyond which one solution becomes better than another. Below are the results obtained where the x-axis is the weight assigned, while different lines are the structural systems analyzed to read the relative ranking score for each one. From the graphs, it can be seen how the score associated with GWP increases, the wooden structures manage to increase their overall ranking while the others tend to decrease. As far as transparency is concerned, as the weight increases, all the structures improve their final rating, with the steel Vierendeel solution growing more. Finally, with respect to mass, the rating increases proportionally as the weight of the RC arch and steel, Vierendeel wood and steel solutions increases. From this analysis, it is, therefore, possible to understand which parameter positively or negatively influences each solution.





By plotting the scores obtained for each structure on a radar graph, it is possible to make a further comparison between the different alternatives, so that it is very easy to identify the parameters for which each structure performs best. It is interesting to note that the UHPFRC arch solution has a graph that ranks in the middle of the results, however, through the multi-objective evaluation system illustrated, it is clear that it is the solution that best maximizes the different requirements within the design intent.

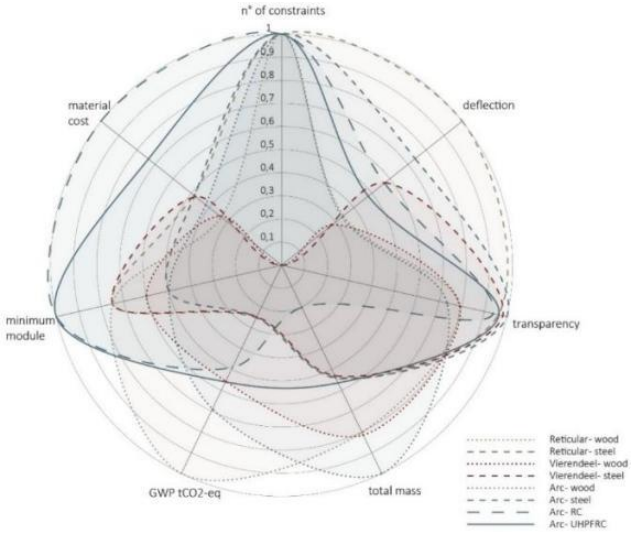


Figure 8 Radar graph of results obtained for the eight solutions.

After this first quick assessment, different weights can be assigned to each parameter. As anticipated, high weight was assigned to GWP, transparency and less visual impact, and total mass to minimize loads. Below are the results obtained.

Table 3 Result - Dimensionless data with different parameters' weight.

	n° of constraints	Deflection [%]	Transparency [%]	Total mass [kg]	GWP tCO_{2eq}	Minimum module [m]	Cost [€]	Rating
WEIGHT	0.05	0.1	0.25	0.15	0.2	0.15	0.1	
Vierendeel - steel	0.000	0.572	0.982	0.529	0.247	0.750	0.475	0.591
Vierendeel - wood	0.000	0.279	0.792	0.815	0.557	0.600	0.342	0.584
Reticular - steel	1.000	1.000	0.963	0.543	0.253	0.750	0.487	0.684
Reticular - wood	1.000	0.343	0.787	0.802	1.000	0.750	0.336	0.747
Arch - steel	1.000	0.740	1.000	0.537	0.250	0.500	0.482	0.628
Arch - wood	1.000	0.335	0.736	1.000	0.690	0.500	0.419	0.672
Arch - RC	1.000	0.569	0.939	0.203	0.490	1.000	1.000	0.720
Arch - UHPFRC	1.000	0.481	0.965	0.564	0.561	1.000	0.738	0.760

4.3 Topological optimization

In this section, we show the process followed to achieve the arc shape. As mentioned before, to achieve a lightweight and visually permeable structure, a topological optimization problem was set up. Topological optimization refers to

a process that, given specific boundary conditions, allows the reduction, redefinition, and distribution of material connections to achieve an efficient shape. It was decided to employ a topological optimization process because, unlike shape optimization, it allows a completely new structural scheme to be found rather than defining the optimal dimensions of a predefined model. This procedure, therefore, allowed us to find the most efficient shape given the boundary conditions.

By optimizing the structural element, it is also possible to minimize the material used and consequently reduce the GWP (Block, 2020), employing the available resources more efficiently.

During the topological optimization process, it was necessary to define boundary conditions such as:

- - Elastic modulus of the material
- - Poisson's modulus
- - External constraints
- - Actions acting on the system



Figure 4 Scheme of topological optimization objectives

In addition, it is important to establish the objective of the optimization process by means of a function and a constraint (Duriez et al. 2022). In the case under study, the optimization was aimed at finding the form that could maximize the structural stiffness (defined as a function) and minimize the volume (defined as a constraint). Using the Abaqus CAE software, all parameters were set and through 25 iterations it was possible to obtain the shape that combines maximum stiffness and minimum volume. The approach behind the optimization process is to achieve structural performance without adding material to the structure but by

finding the most efficient shape. The search for the best-performing structural scheme means finding configurations that reduce internal stresses by actually increasing the potential of the material used (Block, 2020). Following the design phase, as with the previous analyses, different materials were evaluated to assess how well they met the initial requirements.

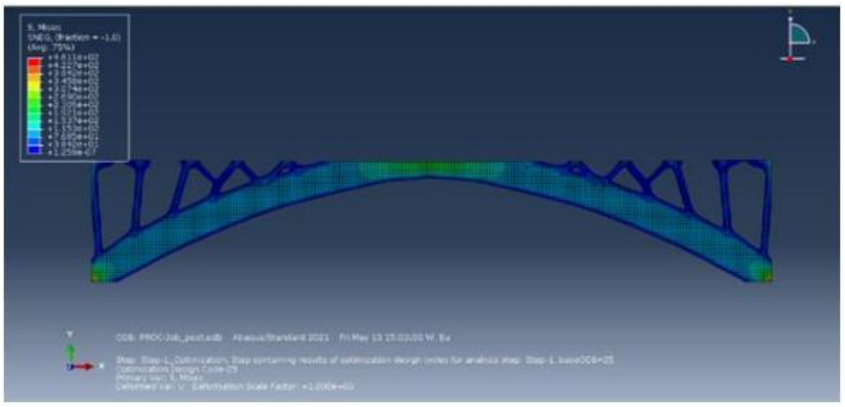


Figure 13 Result of topological optimization and internal stresses.

Through topological optimization, a suitable form was then found to fit the context and pre-set constraints. As can be seen from Figures 9-10, the result obtained is based on an arch and struts capable of collecting the upper loads. This form was used as a new starting point for the design of the structure, which made the arch its characteristic element.

The optimization process did not just stop at topology. In fact, if the identified structural scheme allows for maximum stiffness, it is also important to define the sections that compose it to optimize the amount of material used. To evaluate the efficiency of the sections, the geometric performance index η_g was used. This parameter expresses through a coefficient the efficiency of the section, varies between 0.33 (rectangular section) and 1 (ideal section) and is defined as:

$$\eta_g = \frac{W_s}{A_c \times y_i}$$

Where W_s represents the modulus of resistance, A_c is the cross-sectional area, and y_i is the distance from the center of gravity. Through this parameter, several sections were evaluated. Thanks to the prefabrication and properties of UHPFRC, it is possible to design ad hoc sections. In the design of the section, it was

intended to maximize the inertia in the direction of deflection without minimizing it in the other direction. In fact, since these elements are subject to both bending and compression, it was desired to avoid a principle of buckling in the lateral direction. As can be seen from the values, the section chosen allows for a better geometric performance than the classic rectangular section (+36%) while saving material, thus maximizing inertia in the direction of inflection without reducing it excessively in the other direction.

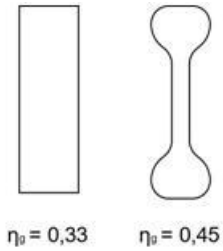


Figure 5 Beam sections compared.

As in the previous cases, in order to analyze this solution from several points of view, different materials with which the arch can be constructed are taken into consideration. In this case, in addition to steel and timber, reinforced concrete and high-performance fiber-reinforced post-tensioned concrete (UHPFRC) were also considered. The choice of analyzing the behavior of these types of concrete is due to the introduction of the arch into the structure. It performs an important structural function and, working in compression, concrete is an optimal solution due to its high compressive strength. These configurations were also modeled using RFEM software and analyzed using static LCA analysis to obtain data for comparison.

5 Conclusions

The construction sector increasingly becomes a complex field in which to operate, having to take into account many factors. When it comes to the refurbishment of the built heritage, this complexity increases, also having to take into account the constraints that the pre-existence imposes on the project, given the desire to restore it. The following contribution showed how accepting the challenge of working on the pre-existence proves to be an opportunity to trigger

a process of optimizing solutions starting from the limits, constraints, and objectives that the project aims to achieve. Thanks to an in-depth analysis of the context and the pre-existence, a refurbishment project was gained to give new value to the military battery of Capo d'Orso and to allow it to take advantage of the landscape of this area, affecting the historical elements as less as possible. A multi-objective analysis made it possible to systematize the goals of the project. Different solutions (structural systems and materials) were analyzed to assess how much they impact different factors related to architectural value, environmental impact, cost, and construction site. Thanks to assigning different weights to those objectives, we were able to quantitatively assess the solutions and choose the most suitable according to the design will.

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Gender Equality: Driver or Brake of Sustainability

Jole Miriam Corrao*

Università di Pisa
Lungarno Antonio Pacinotti, 43, Pisa

Maria Zifaro

Universitas Mercatorum
Piazza Mattei, 10, Roma

* *Corresponding author*

Abstract

In view of a necessary sustainable organizational turnaround, this research aims to reflect on the aspect of social sustainability, which is often given little weight in corporate sustainability programs. The research focuses on one of the most crucial nodes in social sustainability, the gender gap. Through the Gender equality global report & ranking 2023, were highlighted the progress made and the critical issues still to be resolved in terms of corporate gender equality policies
The future developments of the research include interviews aimed at all the HR of companies according to the Mosaic Business Model.

Keywords – Gender gap, social sustainability, knowledge management, diversity management, broken rung

Paper type – Academic Research Paper

1 Introduction

"Pas de retraité, sur une planète brûlée. Retraite, climat, même combat"!" shout the streets of Paris. The millennials and the Parisian Generation Zeta, protesting against the pension reform proposed by the Macron government, remind us, to the rhythm of Techno, that there is no environmental sustainability without social justice. The popular opposition in the streets of Paris and again the wave of resignations, which started in America and forcefully swept through Europe as

well, represent the symptomatology of a sick production system that is turning in on itself; a system that can only survive by taking the path of sustainability.

This 'Great Refusal' (Marcuse,1967) makes it clear, however, that environmental and organizational social sustainability must be inextricably linked within the meshes of a new business model, in which there can be no creation of value if, in addition to economic performance, its impact on the environmental and social context of the reference is not considered. The paper starts and defines itself in light of the economic-managerial paradigm that dominated the world before the advent of the concept of sustainability.

The meager environmental and social sustainability implemented by human beings to date is now an unshakable certainty. The individual has exploited ecosystems and produced an alteration of the balance of nature, which has been supplanted by artificial balances (Bravo, 2009). Intensive exploitation has enabled industrialization, generating progress whose harmful effects have been underestimated for a very long time (Sabellotti and Sabelloti, 2009). The opposite has been the gradual emergence of the new paradigm of sustainability, which has radically penetrated the operational logic of government bodies, international organizations, and private and public sector institutions: organizational strategies today must include sustainability objectives and these must be interdependent with financial ones.

Add to this the imminent European political objectives of the ecological transition, to be concluded by 2030 (Green Deal-2030/2050) and, in terms of social gender equity, the achievement of 40% female presence in the Boards of Directors of all European listed companies by 2026. (Woman on board- 2026)

This paper focuses on the gender gap, an aspect of the corporate social sustainability dimension, noting the critical issues, which persist to date, for its total overcoming. (Heisig and Kannan, 2020).

2 Theoretical framework

Increasingly companies are incorporating environmental sustainability objectives into their strategic plans in order to reduce their impact on ecosystems through 'green practices'. (Martinez et al., 2022). Undoubtedly numerous evidences attest that sustainability strategies increase financial performance in the long run (Eccles at al., 2013; Arayakarnkul, 2022). However, the efforts made in the direction of environmental sustainability still do not match those of social

sustainability, as Istat notes, in the Italian context. (Permanent Business Censuses, 2020) Yet a proper orientation toward organizational sustainability would require a holistic approach combining development, economic performance, social and environmental sustainability (Vota, 2020). On the other hand, giving due weight to the development of organizational social sustainability would offer significant benefits on employee turnover and the meaning of work (Guerci et al., 2019) strongly compromised the latter given the wave of large resignations recently witnessed. Undoubtedly, considering that the reasons behind the aforementioned resignations are not materialistic in nature, but ethical, relational and cultural, in order to regain the engagement of the resigning employees, that of social sustainability, a concept that encompasses the aforementioned aspects, would seem to be the only viable path (Kuzior et al., 2022). 2022; Criado, 2021, Gherardi,1995). Although there is no lack of gender approaches to organizational studies (Calàs and Smirchic, 1999) one of the areas that suffer most from "gender blindness" is knowledge management (Heising and Kannan 2020); rethinking it from a gender perspective seems necessary, in the direction of implementing social sustainability.

The paper starts from a conceptual foundation, that of sustainability, as a tool not only to improve the distortions created by modern capitalist economic systems, but also as an opportunity for the creation of value and greater competitiveness within organizations and beyond.

This concept, which is the subject of European and international regulations, is increasingly being discussed, especially in the context of business ethics, in the direction of moving away from a type of business dominated only by profit, in the face of the need to push the business world towards progress and a sustainable future.

The importance of the gender gap as an influencing element of organizational structures has also been studied by Hofstede (1991) who identified four dimensions of diversity: power distance, uncertainty avoidance, individualism/collectivism, and masculinity/femininity.

According to Hofstede, masculinity/femininity refers to the emphasis on work-related rather than personal goals.

According to Hofstede's definition (1991), societies in which masculinity prevails define gender roles more rigidly than societies in which femininity prevails.

The most significant and alarming fact that the paper intends to reflect on and investigate, as a priority, concerns the masculinity/femininity dimension that emerges from Hofstede's research.

He argues that biological factors based on gender also influence culture and the division of roles, which is then reflected in society. The more the roles are differentiated, the more society will display characteristics that can be called masculine. Conversely, the more interchangeable the roles, the more feminine characteristics society will display. In the former, the man must impose himself and show that he is the strongest, while in the latter, the roles will be less differentiated (Zifaro, 2010).

From a corporate point of view, it can be said that a country's masculinity index indicates the degree to which it accepts its right to interfere in the private lives of its staff. In countries characterized by femininity, there is an inclination on the part of workers towards small companies and a rejection of any interference by the latter in their private lives. It is also noted that in countries characterized by a masculine culture, individuals are skeptical of others, showing an intrinsic aversion to work.

In such countries, as opposed to those considered feminine, employees generally prefer an increase in salary to a reduction in working time.

The reasons why a state exhibits masculine rather than feminine characteristics are mainly to be found in history in that they are maintained throughout the generational transition, with no tendency in modern nations to converge sharply on one or the other form.

The degree of masculinity profoundly affects the form of humanization of work, i.e. the term humanization is interpreted in the light of the meaning given to the word human. In masculine cultures, it is important to be recognized, to have a career and to fulfill oneself. In contrast, in a society with a feminine culture, the aim will be to establish real cooperation between workers.

It is possible to identify different ways in which culture influences organizations and those who live and work in them. In order to overcome this inequality, numerous European attempts have been made to push national policies in the direction of gender equality, so that they encourage gender equality in both the work and family context, with the aim of breaking down gender stereotypes and sources of inequality.

In this regard, let us recall the document, published by the European Union in 2021, A Union of Equality: The Strategy for Gender Equality 2020-2025, which sets out key objectives and actions to achieve gender equality by 2025.

Currently, women in managerial positions in Italy account for about 27% (Istat) of the total. The glass ceiling, or glass ceiling - the obstacles that women workers encounter in their careers to reach top positions - is still a widespread phenomenon.

In managerial positions, gender differences in income are highest, at around 23% (Istat).

No less negligible is the phenomenon of the sticky floor - sticky floor - used to illuminate the vertical segregation in which women are forced into medium-low and, consequently, lower-paid positions (UNI/PDR, 2022).

All this presents a discouraging picture, yet many studies note that gender equality is a driver of economic growth and development (Profeta, 2020).

No less important then, to point out that more inclusive companies generate higher value.

Several studies and company case studies have noted the positive correlation between the presence of women in top positions and company performance (McKinsey & Company, 2020.).

In particular, the positive effect of gender quotas- which led to an increase in the number of women in decision-making positions- was found in terms of economic and social benefits on companies (Ferrero et al, 2018).

In particular, the positive effect of gender quotas-which led to an increase in the number of women in decision-making positions in terms of economic, as well as social, benefits on companies was found (Ferrero et al, 2018).

3 Research question

The paper focuses on the gender gap, an aspect of the corporate social sustainability dimension, noting the critical issues, which persist to date, for its full realization.

In 2021, the Word Economic Forum declared that no country in the world has fully closed the gender gap, only Iceland, Norway, Finland and Sweden have reached eighty percent of the target.

For this reason, we want to investigate the importance of a sustainable organizational form, defining its essential features with the aim, starting from the

published ranking of the 100 companies where gender equality has been achieved, to investigate the activities implemented by the Italian companies present in order to answer the following research question:

> *How in the Italian companies ranked in the Equileap-global-report 2023 does the relationship between environmental and social sustainability contribute to a holistic organizational transformation in the light of gender equity?*

4 Methodology

Starting from Hofstede's reflections, the research was structured in two steps.

The first step of the research involves the analysis of the Equileap-global-report 2023, published in March, which ranks the best companies in terms of gender equality; then, in a second step, we want to investigate what actions have been put in place to achieve the result of gender equality in order to understand how sustainable development, which has also manifested itself through gender equality, has been implemented.

Indeed, sustainable development is not possible without full gender mainstreaming, nor is full gender equity possible without a rethinking of the impact of every business choice.

The analysis will be qualitative by conducting interviews with the HR of the companies using as a guide the "Mosaic Business Model"[1] oriented to enhance vision, value system, internal relations and external relations, so that a qualitative comparison can be made to identify best practices.

The methodology used is that of the case study because it is the most suitable and most effective for seeking answers to questions of "how" and "why" (Yin, 1994), when research is aimed at exploring articulated and complex phenomena within particular contexts.

5 Search results: The first step

The ranking of the world's 100 best companies for gender equality in 2023, according to data compiled by the international organization Equileap, published on 1 March 2023 (Gender equality global report & ranking 2023) by the

[1] *For the "Mosaic Business Model" see De Toni A. F., Barbaro A., Visione evolutiva. Un viaggio tra uomini e organizzazioni, gestione strategico e complessità, ETAS, 2010, p. 202-204 and De Toni A. F., Rullani E., Uomini 4.0: Ritorno al Futuro. Creating value by exploring complexity, Franco Angeli, 2018, p. 124-125.*

international organization Equileap provides data and insights on gender equality of companies listed in the major stock exchange indices.

Equileap is the leading organization providing in-depth data and information on Gender Equality in business, focusing on the social aspects of gender equality policies and practices.

Equileap's research examined the gender equality (equality between men and women) levels of almost 3,787 companies in 23 markets.

This method involves analysis using 19 criteria inspired by United Nation woman's empowerment principles. The first scorecard concerns the area of gender balance in leadership and workforce: the gender balance in the board of directions, among executives and on the executive board, and in senior management is taken into account with respect to the gender balance of the entire workforce, with a view to the advancement and career opportunities.

The second scorecard, on the other hand, pays attention to equal pay and work-life balance: the gender pay gap, the presence of a living wage for all workers, parental leave programs are analyzed and the presence of the flexible work option is noted.

The third area concerns the company policies put in place to promote gender equality, with particular regard to measures taken to ensure equal access to training and career advancement, regardless of gender, measures to ensure non-discriminatory recruitment, anti-violence programs, sexual abuse and harassment, including verbal and psychological, measures to ensure the safety of employees in the workplace, on their way to and from work and the safety of suppliers in the workplace, guarantees to protect human rights, a commitment to reducing social risks in the supply chain and the promotion of ethical sourcing and diversity, and the implementation of internal ethical compliance complaint systems.

The fourth scorecard covers the area of commitment, transparency and accountability and assesses the commitment to the principles of United Nation women's empowerment and the promotion of an independent and body-certified gender internal audit system recognized by Equileap. The last area of assessment takes into account gender disputes detected by Equileap itself and occurring within companies, i.e. incidents involving sexual harassment and gender discrimination.

The Report, in its 6th edition, reports data from 3,787 listed companies worldwide for 2023 using a unique and comprehensive methodology called the Gender Equality Scorecard™.

The global average score of the 3,787 companies increased from 34% in 2021 and 37% in 2022 to 41% this year.

Here is the complete ranking of the 100 best companies for gender equality.

1. Mirvac
2. Diageo;
3. Medibank;
4. Allianz ;
5. UBS Group;
6. Aena;
7. Yara International;
8. National Grid;
9. GPT Group;
10. Westpac;
11. L'Oreal;
12. Sodexo;
13. ASX;
14. CIBC;
15. Standard Chartered;
16. Transurban;
17. Enagás;
18. DNB;
19. Dow;
20. Dexus;
21. Experian;
22. Commonwealth Bank;
23. Procter & Gamble;
24. Carsales.Com;
25. International Flavors & Fragrances;
26. Admiral Group;
27. Moneysupermarket.Com;
28. AGL Energy;
29. SSE;
30. Schneider Electric;
31. Vodafone;
32. Tele2;
33. Smartgroup;
34. Sanofi;
35. Orang;
36. S&P Global;
37. AstraZeneca;
38. Viva Energy;
39. Danone;
40. WPP;
41. Johnson Matthey;
42. Tate & Lyle;
43. Novartis;
44. Castellum;
45. Enel;
46. Vivendi;
47. Wolters Kluwer;
48. BHP;
49. IAG;
50. GlaxoSmithKline;
51. Viaplay Group;
52. QBE;
53. Publicis Groupe;
54. Cummins;
55. National ;
56. M&G;
57. ABN AMRO;
58. ITV;
59. Sparebank;
60. DSM;
61. JPMorgan Chase;
62. Saint-Gobain;
63. Biogen;
64. Wells Fargo;
65. Storebrand;
66. Burberry;
67. Xero;
68. Royal Bank of Canada;
69. Unilever;
70. Landsec;
71. Accenture;
72. UniCredit;
73. Origin Energy;
74. Metcash;
75. Bank of America;
76. Philip Morris International;
77. Capgemini ;
78. TAG Immobilien;
79. Eni;
80. Schibsted;
81. Covivio;
82. Hera;
83. BBVA;
84. OZ Minerals;
85. BNP Paribas;
86. Societe Generale;
87. Covestro;
88. EDP;
89. Kering;
90. Telenor;
91. Goldman Sachs;
92. General Mills;
93. Red Eléctrica;
94. Stockland;
95. Challenger;
96. Meta (ex-Facebook);
97. AT&T;
98. Super Retail Group;
99. VF Corporation;
100. Croda.

The Italian companies in the ranking are Enel (in 45th place), Unicredit (in 72nd place), Eni (in 79th place) and Hera (in 82nd place).

It emerges from the ranking that the best markets for gender equality in companies are France, Spain, Italy, Norway, the United Kingdom and Australia; in contrast, the United States, Japan and Hong Kong have the lowest average scores globally. The markets with the highest scores for gender equality are France (55%), Spain (54%) and Italy (53%), tied with Norway (53%). They are closely followed by the United Kingdom (52%) and Australia (50%).

To understand the concreteness of the goals achieved and highlighted by the report, it is also worth observing the major criticalities, at a micro-structural level, detected by the research, regarding the gender gap.

The study shows that with respect to some key criteria, progress is still slow, e.g. with regard to the pay gap, it is worth noting that less than 1% of companies have completely closed the pay gap. The vast majority (78%) of companies globally have not published any information on the pay gap between male and female employees. Furthermore, only 28 companies globally, out of 3,787 companies, have closed the pay gap, 9 more than in 2022. All of these companies have an average unadjusted pay gap of +/-3% affecting all employees.

As far as top management is concerned, women in top positions are still very rare. A minority of 6% of global companies have a female CEO, 15% have a female CFO and 8% have a female chairman of the board. Looking at representation from top to bottom, women make up 28% of board members, 20% of executives, 26% of senior management and 38% of the total workforce. Gender balance within a company is rare, with only 18 companies globally achieving 40-60% women at all levels (board, senior management, management and workforce).

Other critical issues emerge in relation to the transparency of gender equality data: Only 22% of companies globally publish their gender pay gap (up from 17% in 2022 and 15% in 2021), Transparency is a step towards closing the pay gap, and disparities in transparency between countries remain huge: 98% of Spanish companies publish their gender pay data, compared to only 12% of US companies.

Globally, 40 per cent of companies have not published a policy against sexual harassment; however, there is a gradual improvement in this area compared to the last two years (47 per cent had not published it in 2022 and 51 per cent in 2021).It is worth noting that the researchers noted that a key factor in the good performance in the markets surveyed is the presence of national laws requiring

the disclosure of gender equality data, such laws greatly increase corporate transparency.

In France, for example, there are mandatory quotas for female representation on the board of directors (40 percent) and among managers (must reach 30 percent by 2027, 40 percent by 2030), and data on the pay gap must be reported to the government. In Spain, companies must report paying gaps and have extensive gender equality plans.

Last but not least is the huge gender gap that plagues the technology sector at all levels. It is the worst-performing sector in the dataset and is still held back by pervasive gender discrimination. More than half of the women in the sector report having experienced some form of sexism in the workplace in the last year.

The presence of the 'broken rung' continues to hinder women, to the extent that promotions of women to management positions occur at almost half the rate of men. Although Deloitte estimates that gender equality in the said industry has improved by 6.9% since 2019, however, this increase in female representation in the industry alone is not enough to eradicate the sexist culture present in the tech industry, an area still felt to be an 'old boys' club'. Ultimately, the Equileap research results show an improvement within the technology sector, but a deterioration in performance compared to other sectors that are improving at a faster pace.

"Gender equality global report & ranking 2023" compiled by Equileap

6 The Second step and future developments

From the month of September, interviews will be carried out with the HR of the Italian companies in the ranking using the "Mosaic Business Model"[1] in order to investigate how sustainable development, including gender equality, has been implemented.

From the analysis and comparison of the results of the interviews, it will be possible to expand on best practices that, although they cannot be generalized, can be used as a reference for the implementation of actions in the field of gender equality.

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Social Media in Agribusiness: The Way for Sustainability

Niccolò Paoloni

Law Department, Roma Tre University
Via Ostiense 161/165, 00154

Rubina Michela Galeotti*

Department of Business Studies
Roma Tre University,
Via Silvio D'amico, 77,00145, Rome (RM) Italy

Maria Rita Filocamo

Department of Economics, Management and Institutions
University Federico II of Naples,
Via Vicinale Cupa Cintia, 26, 80126,Naples (NA) Italy

* *Corresponding author*

Abstract

This paper aims to investigate which are the relationships between Italian agri-food companies, governed by women, sustainability and social media. The aim of this paper is to analyse how agri-food companies are sustainable and if disclose their way of being sustainable through social media. In addition, this paper aims to investigate what economic benefits Italian agri-food companies that convey sustainability through social media receive. This work is supported by a qualitative methodology based on a case study. The results of any studies have begun to show that there is a close connection between agribusinesses and sustainability. Furthermore, SMEs are not only tied to tradition, but also to innovation; it was also found that the positive effects, produced by the diffusion of new information technologies, produced improvements in efficiency, product quality, environmental sustainability and new communication channels; all of these are important factors that can influence business relationships. It was also possible to see that through the use of social media, agri-food companies were able to communicate their commitment to sustainability to a large audience. Communicating a company's level of sustainability, also in the agri-food sector, through social media can bring economic benefits. This paper aims to expand the literature on the topic of sustainable agri-food companies in Italy, with a special focus on the use of social media in women's businesses.

Keywords – Agri-food, sustainability, social media, gender, SMEs

1 Introduction

This paper aims to investigate which are the relationships between Italian agri-food companies, governed by women, sustainability and social media (Dadi et al., 2021, Friedrich et al., 2012, Cosentino et al. 2021). Thus, the aim of this paper is to analyse how agri-food companies are sustainable and if disclose their way of being sustainable through social media. In addition, this paper is directed to investigate what economic benefits Italian agri-food companies that convey sustainability through social media receive.

This work is supported by a qualitative methodology based on a case study. This methodology allows the description of the meaning of actions and events in the social world, which researchers interpret. It is used mainly when multiple variables are observed, so many data sources are needed, hopefully triangulable, and benefits from the previous development of theoretical propositions that guide data collection and analysis (Yin, 2009). The description of the case is based on semi-structured interview. The information collected using semi-structured interviews is interpreted through qualitative inductive content analysis. There are many established forms of interview methods utilized to gather insights into a variety of phenomenon, such as focus group and in-depth interviewing. The family of qualitative interviews encompasses ways of questioning that "differ in the degree of emphasis on culture, in the choice of arena or boundaries of the study, and in the specific forms of information that are sought" (Rubin and Rubin, 1995, p. 19). The interview method is the art of questioning and interpreting the answers. Interviews were conducted with woman chosen from those who are members of the association "Le donne del vino". "Le donne del vino " is a nonprofit association that promote wine culture and the role of woman in the wine production chain and society as a whole.

The results of any studies have begun to show that there is a close connection between agribusinesses and sustainability. Furthermore, SMEs are not only tied to tradition, but also to innovation; it was also found that the positive effects, produced by the diffusion of new information technologies, produced improvements in efficiency, product quality, environmental sustainability, and new communication channels; all of these are important factors that can influence business relationships. It was also possible to see that using social media, agri-food companies were able to communicate their commitment to sustainability to a large audience. Consequently, communicating a company's level of sustainability, also in the agri-food sector, through social media can bring economic benefits.

This paper aims to expand the literature on the topic of sustainable agri-food companies in Italy, with a special focus on the use of social media in women's businesses. This study therefore highlights how all those new technologies, such as social media, succeed in improving the economic results of companies. It also highlights how the use of social media to communicate the sustainability of a company serves to improve the environmental conditions within which the company operates.

2 Literature

In the last decade, agri-food sector has experienced an exponential growth. The agri-food sector contributes to food safety, to fill gaps in supply and demand, to improve traceability and product quality (Dadi et al., 2021). Indeed, due to widespread discontent food organizations have been called to adopt more sustainable practices by government, stakeholders, consumers and the world at large (Kumar et al., 2022; Friedrich et al., 2012; Troise et al., 2021). The only way for the agri-food sector to achieve the sustainable development goals (SDGs) is represented by the application of the so-called "sustainable development" (Spanaki et al., 2022; Kumar et al., 2022). Cosentino et al. (2021) analysed, about small and medium-sized enterprises (SMEs) belonging to the agri-food sector, the link between technological innovation (IT), relational capital (RC) and intangible value for the environment. Through qualitative research methodology they found a positive link between tradition and innovation in the agri-food sector, which in turn produces positive effects on corporate sustainability. Namagembe (2021) always focusing on the SMEs of agri-food sector, investigated the influence of environmental standards set on the choice by farmers to adopt sustainable practices, i.e. environmentally friendly. Actually, knowledge of environmental issues has prompted farmers to adopt practices that are environmentally friendly. According to Namagembe (2021), the impact of consumer knowledge on his behavior in the agri-food context has also been analyzed in other studies, demonstrating that there is a difference between those who do not know agri-food products and those who are wrong (Torres-Ruiz et al., 2022).

Cavallo et al. (2022) focused on a strategic Agri-Food Plan of Rome above all to try to understand if the Covid-19 pandemic had changed priorities in the sector, considering food strategies and sustainability. The analysis of consumer behavior on the choice of food and drink after the Covid-19 pandemic also involved other studies (Ben Hassen et al., 2022; Cordeiro et a., 2021).

Other studies (Mangla et al., 2022; Annosi et al., 2022; Bartoli et al., 2022; Rialti et al., 2022) concern how individuals and their social contexts can influence the agri-food sector and especially if the diffusion of technology. In fact, technology plays a central role in guaranteeing sustainable development in the agri-food sector because it makes the use of resources more efficient and eco-friendlier for the population. In this case, the introduction of 4.0 technologies leads to talk of a type of business defined as Agritech or Agri-Food 4.0 (Rialti et al., 2022; Spanachi et al., 2022; Dadi et al., 2021)

Kocollari et al. (2022) have verified whether the dimensions of the social capital (bridging, bonding and linking) contribute to improve crowdfunding campaigns by comparing the agri-food, cultural and technological sectors. The results show that the number of financiers involved in the agri-food sector is certainly greater than in cultural and technological projects. Moreover, several studies have focused on agri-food companies that use crowdfunding platforms (Cillo et al., 2019; Testa et al., 2019; Troise et al., 2021).

In this context, social media networks become more and more popular and their analysis also helps to understand how people deal with environmental issues (Pilař et al., 2018). Simeone and Scarpato (2020) through a survey conducted on 162 people in Campania, Benevento (Italy) attempted to examine the link between the information coming from social networks and the food choices of consumers. The result is that the information is linked to food consumption choices that are not sustainable from an environmental point of view. Simeone and Russo (2017) created a theoretical model using game theory to model the strategic use of social media by food companies. Subsequently, an online survey was sent to 722 Italian food consumers. What emerges is that when social media become influential, consumers being more informed are more concerned about the quality of the food; those who instead use the mass media, having less information, prefer simply cheap products. Van der Merwe et al. (2022) screened 223 South African female consumers and workers via social media to test the focus on food labels based on prior knowledge, marketing, and family choices. The result has been a strong dependence of marketing factors on the use of food labels.

Thus, the research questions are the following:

RQ1:How much, do agri-food companies, convey that they are sustainable through social media?

RQ2:What benefits, in terms of economic outcomes, do social media outreach of corporate sustainability bring?

3 Methodology

We decided to use the qualitative methodology based on a case study (Yin, 2009, Paoloni et al., 2021a; Tyskbo, 2019; Modaffari et al., 2019). The case study has the characteristic that it can serve those researchers who want to examine a phenomenon related even only to its context (Yin, 1984). Using the case study methodology, researchers can describe actions and events in the social world (Covaleski and Dirsmith, 1990).

This type of research has been defined as ethnographic (Paoloni et al., 2020; Easterbrook, Singer, Storey, & Damian, 2008) as it focuses - through field observations - on cultural practices. In particular, the present research concerns an ethnographic exploratory single case study (Paoloni et al., 2020) as it analyzes a specific association "Le donne del vino" and investigate the relationships between sustainability and social media.

For the development of this study, we obtained data through individual and semi-structured interviews. Semi-structured interviews were conducted (Gupta et al., 2019; Dearnley, 2005; Runeson & Höst, 2009; Horvàt & Szabò, 2019) to guarantee both the interviewees and the interviewer the opportunity to express themselves more freely (Corbetta, 1999; Dunn, 2005; Runeson & Höst, 2009; Paoloni et al., 2020). Therefore, the researcher has a written list of questions to ask on the main topics of interest but there are no closed answers as occurs in the structured interview, so as to elicit spontaneous answers from the respondent (Whitehead, 2005).

To understand the state of the art regarding the topics of sustainability, agrifood and social media, the authors firstly performed a search on Scopus searching for the results that came up if we put in the keywords "Sustainability", "Agrifood", "Social Media". We limited it to publications in English, written in the years from 2012 to 2022, regarding the area "Business, Management and Accounting". We obtained 69 articles, of which, however, we considered 54 articles to be essential after a subsequent skimming.

3.1 Research process

We decided to interview women entrepreneurs belonging to the association "Le Donne del Vino". We sent an e-mail to 21 the women entrepreneurs in the association as far as the Lazio region is concerned proposing an interview. We conducted an interview with seven women entrepreneurs answering to our request, subdivided mainly into three macro subjects. We used the semi-structured interviewed method (Annex 1).

The topics covered in the macro groups were as follows:

- Introductionary information;
- Sustainability;
- Social Media.

The first macro-group dealt with general information concerning firstly the personal information of the female entrepreneur interviewed, such as her age, schooling or previous work experience; secondly, we focused on the company, so we started with general information such as the name of the company, when it was founded or how many employees are employed; then we got to more specific information such as the legal form of the company, the management form, who makes decisions, how roles are divided in the company, how employees are hired or whether there is a female majority working in the company.

In the second macro group, we dealt with the topic of sustainability in agrifood companies. In this second macro group the women entrepreneurs were asked all those questions concerning the concept of sustainability applied to their realities; The initial questions in this group started with finding out whether the concept of sustainability was important to them and their company. Based on the answers received, we then went on to find out how the concept of sustainability was felt in their company, and then we asked them whether they had made investments so that their company would follow sustainability standards and whether they had struggled to find the funds.

The third macro group of questions we asked the female entrepreneurs interviewed concerned social media. In fact, over the last few years, social media have found great space not only in the daily lives of all people, but also in the lives of companies; they have become powerful vehicles of communication and tools through which the company can reach the end consumer more quickly and directly. In this last group of questions, we started by asking if social media were used in their companies; we then asked about the content of what was shared by them; after these initial introductory questions on the subject, we asked if they

had any benefits from using social media (such as attracting new customers to the company); we concluded this last macro group by asking if social media were in any way valued in the balance sheet.

4 Findings and Discussion

In order to answer the research questions, we have grouped together in to the following tables the results we obtained from the interviews we conducted with the seven women entrepreneurs belonging to the association 'Le Donne del Vino'. The answers were grouped into three macro groups:

- Introductonary information;
- Sustainability;
- Social Media.

The table 1 shows that the average age of women entrepreneurs is over fifty; there are three out of seven women over fifty, two women between thirty and forty, and only one woman under thirty and one woman between thirty and forty.

The women interviewed work in companies that are at least 30 years old, 70% of the companies were founded before 1989, while 30% between 2004 and 2012. All the enterprises are family businesses and that therefore the female entrepreneurs are at their first work experience, except for one female entrepreneur who is at her second experience in entrepreneurship, as she had previous experience in a marble company.

We highlight how almost all of the companies are female-dominated, as six out of seven companies are female-dominated, the interviewees noted how women can be more suitable and precise for work in the wine sector, they also pointed out how they find greater flexibility and elasticity during refresher courses in pruning.

Table 1

Introductionary information	Age	"Under 30" (Entrepreneur 2). "Between 30 and 40 years old" ((Entrepreneur 6 and 7). "Between 40 and 50 years old" (Entrepreneur 3). "Over 50 years old" (Entrepreneur 1,4 and 5).
	When the company was founded	"The company was founded around the 1920s" (Entrepreneur 1 and 3). " The company was founded around the 1950s" (Entrepreneur 4 and 5). "The company was founded in 1989" (Entrepreneur 2). "The company was founded in 2004" (Entrepreneur 7). "The company was founded in 2012" (Entrepreneur 6).
	Course of study	"I'm graduated" (Entrepreneur 1,3 and 6). "I have a hotel diploma" (Entrepreneur 2 and 7). "I have a technical diploma" (Entrepreneur 4). " I have a diploma from the classical high school" (Entrepreneur 5).
	Previous entrepreneurial activities	"I had previous experience in a marble company" (Entrepreneur 1). "I have no previous experience, because it was a family business and I started working here straight away" (Entrepreneur 2,3,4,5,6 and 7).
	Female majority	"Yes there is a female majority in the company" (Entrepreneur 1,2,3,4,5 and 6). "No there isn't a female majority in the company" (Entrepreneur 7).

With regard to the second macro group we analysed, i.e. the one dealing with sustainability issues, we noted how the concept of sustainability is relevant by all the female entrepreneurs interviewed, as they believe that in this historical period it is an element on which all stakeholders pay a lot of attention (Table 2).

Thus, the concept of sustainability is widely shared within the companies surveyed; despite this, many of the female entrepreneurs interviewed pointed out various difficulties in making their companies more sustainable. The issue that they highlighted most is an economic one: it is well known that making a company sustainable has very high costs and does not give the same amount of products, hence it follows that small companies are not able to sustain large expenses with regard to sustainability.

Additionally, we extrapolated from this second macro group that all of the businesswomen pointed out that customers in recent years have placed great importance on the concept of sustainability and how this can influence sales and how the company is viewed externally. As a company that follows all sustainability requirements and produces has a greater chance of selling and expanding its market than one that does not.

Table 2

Sustainability	Sustainability in agrifood world	"Sustainability is very important in the agrifood world and green certification is a key part of it" (Entrepreneur 1 and 3). "Sustainability is key, because farms consume the most water" (Entrepreneur 2). "Sustainability is important not only for the environment but also for the entrepreneur to sell more products" (Entrepreneur 4). "Sustainability is important but not so easy to achieve" (Entrepreneur 5). "Sustainability is important" (Entrepreneur 6 and 7).
	Concept of sustainability in the company	"The concept of sustainability is widespread in the company and shared with all employees" (Entrepreneur 1, 3,4,6 and 7). "The concept of sustainability is seen as a goal to be achieved every day" (Entrepreneur 2). "The concept of sustainability is important because it is linked to the healthiness of the territory" (Entrepreneur 5).
	Major difficulties	"I didn't find any, because being a family business the concept of sustainability and related investments had already been made" (Entrepreneur 1 and 3). "The greatest difficulties were in finding the funds to invest in sustainability" (Entrepreneur 2 and 7). "I found the greatest difficulties in interpreting the new data through applications" (Entrepreneur 4). "The greatest difficulties were found in the higher costs that have to be incurred to achieve a sustainable style of business, as equipment considered sustainable or packaging costs more" (Entrepreneur 5 and 6).
	Customers and sustainabilty	"Customers in recent years have shifted a lot of their attention to checking that a company is sustainable and therefore respects the environment; it has become a factor in selling more so it is important to communicate the company's sustainability to the outside world" (Entrepreneur 1,3,4,5,6 and 7). "Customers attach a lot of importance to the concept of sustainability but I believe that there is a lack of correct information about it" (Entrepreneur 2).

Finally, in the last group, i.e. the one where social media is included, it is retrieved that social media is used by all female entrepreneurs (Table 3). All the female entrepreneurs interviewed pointed out that during the last few years they have used social media more, mainly to advertise their company. The use of social media in recent years by the women entrepreneurs interviewed has led them to be able to make their products and their company known to a larger audience of customers. In addition, using social media, they were able to sponsor their events at a much lower cost. The interviews thus show that all the women interviewed have found many benefits in using social media, but that they are unable to quantify the benefit, let alone value it in the balance sheet. This suggests that

future research could be done on how to value the use of social media in the balance sheet.

Table 3

Social Media	Mostly used	"Instragram and Facebook are the most used social media in the company" (Entrepreneur 1,2,3,4,5,6 and 7). "In addition to instagram and facebook we also use LinkedIn,Twitter and TikTok" (Entrepreneur 2). "In addition to instagram and facebook we also use Wechat for orders in China" (Entrepreneur 3). "In addition to instagram and facebook we also use YouTube" (Entrepreneur 7).
	What is share	"We share company images and publicise events" (Entrepreneur 1 and 2). "We share updates to raise product awareness" (Entrepreneur 3). "We share events, new wine releases and general information about our company" (Entrepreneur 4). "We share the life of the vineyard and the most important moments of the company" (Entrepreneur 5 and 6). "We share processing, bottling, the vineyard, promotions and events" (Entrepreneur 7).
	Benefits received	"I find many benefits from using social media such as visibility, but I cannot quantify the benefits economically" (Entrepreneur 1,3,4 and 6). "The benefits a company receives from using social media are many, but the most obvious one is that it attracts many customers and thus we see economic benefits in terms of turnover" (Entrepreneur 2,5 and 7).
	Is valorized in budget	"I do not believe that social media are valued in the budget" (Entrepreneur 1 and 5). "No social media are not valued in the balance sheet" (Entrepreneur 2,3,4,6 and 7).

5 Conclusions, limitations and future research

The aim of this paper was to highlight the existence of a link between agribusinesses and sustainability; secondly, we demonstrated the connection of agribusinesses with innovative concepts such as social media and how their use influences business life. We used the case study methodology to achieve research aims and answering research questions. Our results showed how sustainability is a strong theme in agrifood companies and how social media is an integral part of business life in agrifood companies.

We contributed to main literature (Spanaki et al., 2022, Annosi et al., 2022, Rialti et al., 2022) providing interesting results in the fields. Thus, theoretical and practical implications are several in analysing our evidence. However, this paper has several limitations among which the limited number of interviews in the context of the association and the use of one methodology. Future research is directed to fourthly discuss evidence trying to delete main limitations.

Additionally, future research is directed to compare several organizations in order to validate our results.

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Annex 1

1st Group : Introductionary questions:

- What's your name?
- How old are you?
- What is your marital status?
- Do you have children?
- What was your educational background and what degree do you have?
- Have you had previous entrepreneurial experience?
- What is your previous work experience?
- Why and how did you choose to become an enterpreneur?
- What is the name of your company?
- Describe what your company does?
- When was your company founded?
- Why did you decide to approach the world of agrifood?
- What is the location of your activity?
- How many employees does your company boast?
- Under what legal form was it established? Why?
- What is your role in the company?
- What motivated you to acquire or start this company?
- What are the objectives pursued by company?
- What are your personal goals to pursue through your entrepreneurial activity?
- Did you find it difficult to raise funds? If so, which ones? Are these difficulties related to the fact that it is a women's company?
- Is there a female majority working in the company?
- Why is there a female majority in the company?
- Do you think it is easier to found a female company? If yes, why?
- How are staff selected?
- How are roles and tasks distributed in the company?
- How are decisions made within your company?
- How is corporate performance measured?
- What is the management style adopted by you?
- How did you find out about the existence of the association "Le Donne del Vino"?
- Why did you decide to join the association?

2nd Group : Sustainability

- The concept of sustainability is very important nowadays, do you think it is also important in the world of agrifood?
- How is the concept of sustainability perceived within the company?
- How much and in what way do you think the external environmental (understood as the cultural and political context) influences business dynamics? What opportunities? What threats?
- Do you have any precautions in the relation to sustainability in your company?
- What kind of research was carried out (in relation to sustainability)? What kind of investments were made in this project (in term of sustainability)?
- What are the mojor difficulties encountered in the start-up phase of business and the implementation of innovative elements (referring to sustainability)?
- Do you think your customers attah a lot of importance to the sustainability measures you take?

3rd Group : Social Media

- Do you have social media dedicated to your company? If yes, what are they? If not, why did you decide not to use them?
- Why do you use social media?
- Which social media do you use the most and why?
- What do you share most through social media?
- Do you use social media to promote your company?
- Do you use social media to let customers know about your coomitment to sustainability?
- Have you found benefitsfrom using social media, both in general terms and with regard to sustainability?
- Is the social media tool somehow valorised within the budget?

Gender Equality Certification: An Italian Challenge

Maria Zifaro*

Universitas Mercatorum
Piazza Mattei, 10
Roma

Jole Miriam Corrao

Università di Pisa
Lungarno Pacinotti, 43
Pisa

* *Corresponding author*

Abstract

The 2022 Global gender gap report reveals an impressive figure: total gender equality will be achieved in 132 years (WEF). The discouraging figure reveals not only how far the goal is still, but also how the efforts made aren't enough. The Italian situation doesn't seem particularly comforting, the Gender Index estimates place Italy well below the European average. The gender mainstreaming approach, spread by the European Union and applied in every gender equality strategy, has taught us the problem is not only to "increase" the number of women in a series of processes, but to modify them to give space to the involvement of both women and men. Initiatives specifically aimed at women aren't enough to bring about major changes, as they, often, restrict to the developing female adaptive strategy within structures sized for man. The world of work and organizational structures offer an interesting window from which to observe the systematic nature of the phenomenon. Talking about an «institutionalized prejudice, doesn't seem wrong, because it is clear that jobs are not always gender-neutral spaces.
However, Italian public and corporate policies seem, fortunately, to move in the opposite direction. The Gender Equality Certification for companies, introduced by the PNRR, seems to reveal the intention to make structural changes to the organizational world. This national certification system is designed to accompanies and encourages companies to adopt appropriate policies to reduce the gender gap in all the most "critical" area (UNI/PRR, 2022).

Keywords – Gender equity, gender politics, PNRR, inequalities

Paper type – Practical Paper

1 Introduction

The 2022 Global gender gap report reveals an impressive figure: total gender equality will be achieved in 132 years (WEF). The discouraging figure reveals not only how far the goal is still, but also how the efforts made aren't enough.

The Italian situation doesn't seem particularly comforting. The nation has positioned itself at the 63rd position in the world. Infact, the Gender Index estimates place Italy well below the European average.

The gender mainstreaming approach, spread by the European Union and applied in every gender equality strategy, has taught us the problem is not only« to "increase" the number of women in a series of processes, but to modify them to give space to the involvement of both women and men» (Guida al Mainstreaming di Genere, EU)

Initiatives specifically aimed at women aren't enough to bring about major changes, as they, often, restrict to the developing female adaptive strategy within structures sized for man. (Criado, 2021)

The world of work and organizational structures offer an interesting window from which to observe the systematic nature of the phenomenon.

A paradoxical but significant situation for the purposes of theme comes from female researchers in Alaska, regarding work clothes, all tailored to male anatomy: «Last week, I peed on myself for the sake of the Alaska climate change study. Gender barriers in science don't always take an obvious form, and they get especially perilous in below-zero temperatures.[…] On a Thursday morning I put on my jacket and walked outside my cabin armed with a pink rubber funnel that claims it "allows you to pee while standing up. It's neat. It's discrete. It's Hygienic." What could go wrong?[…] I followed the directions that came with the pink rubber funnel, willed myself to relax enough to pee while standing up, and let go. A golden trickle came out of the funnel—but it mostly ran over my hand, down my legs and into my socks.» (Coehn, 2017). This testimony, authentic and raw, notes the difficulty of researchers in adapting to work clothes, not designed for them, because created with a flap with the zip that forces them to take off the coverall completely to fulfill their physiological needs, in cases where there isn't an indoor toilet, and to disperse heat. The funnel solution represents one of those adaptive strategies designed, once again, on the measurement of the male body. The resolution proposed, in fact, was to equip researchers with "surrogate penises".

Talking about an «institutionalized prejudice» (Criado, 2021), doesn't seem wrong, because it is clear that jobs are not always gender-neutral spaces.

2 Theoretical framework

It has been noted that theoretical and operational reflections in the organisational sphere continue to manifest themselves according to patterns that can be traced back to 'classical' approaches, even though important conceptual and operational transformations are increasingly emerging among modern and post-modern approaches to knowledge. (Masters)

Observing phenomena from a broader, 'detached' perspective allows us to highlight and understand further elements for investigating the roots or concomitant causes of phenomena, the effects and conditions of which we know mainly from empirical evidence (Sahal 1976).

The environmental change underway, which the scholar Giannessi had described in a far-sighted manner, involves the combination of factors, the system of operations and the composition of internal and external forces; it is now characterised by constantly accelerating dynamics, even sudden changes in perspectives that impose more attentive and conscious methods of research and intervention (Giannessi 1970). This new, constantly evolving scenario forces one to rethink the logics that had settled down over time, not only internally within the structure but also in relation to linearity, absolute rationality, and the possibility of 'controlling' parts of the system.

The interrelationships change, moving from the world of predictability to the probabilistic world, where the economy cannot disregard a broad spectrum of qualitative aspects, with unimaginable effects on organisation (Padroni 1987). In this context, the

the systems of measures traditionally used to understand corporate values and culture. Understanding the dynamism of markets and the environment allows a better view of the elements influencing strategic dynamics (Padroni 2007) that are capable of systemically orienting the behaviour of individuals (Salvioni, Franzoni 2009). With the passage of time, new aspects have emerged that were not sufficiently considered in the past, such as the 'value' of people as individuals characterised by skills and uniqueness.

In the theory of complexity, although it covers different areas, and in the absence of a single unifying vision, it is possible to detect some significant principles common to the generality of natural systems, not forgetting that a methodology also represents a way of thinking (Mitleton-Kelly 1997). Complex systems, unlike 'simple' systems, for which a reductionist description applies, which analyses complex reality by dividing it into individual components which, taken in isolation, would not make it possible to clarify how they function

together, require systemic or synergetic approaches and a new 'common sense' consisting of reading and understanding, in real time, causes effects and interactions (Lissack, Ross, Petzinger 1999).

Complexity can be traced back to a system comprising dynamic aspects that can be open and dispersed, consisting of interconnected elements (Fuller, Moran 1999). In the postmodern view, reality would not be "something that is given to us, but something that we continually create, we weave in communicating it" (Rifkin 2000).

From all this it is safe to say that different organisational models emerge due to the fact that the accentuation of dynamics linked to phenomena such as competitiveness and innovation in the context of generalised structural changes contributes to the growth of complexity (Adinolfi 1999).

Alongside the more traditional category of 'progressive' innovation, marked by an upward process of improvement, initiatives are identified that are capable of changing scenarios, fuelling new development and cost-effectiveness over time (Christensen, Raynor 2004).

The focus on the aspects of complexity, understood as a constellation of shared beliefs and as a set of theories of a scientific community, with applications also in the organisational sphere, makes it possible to approach traditional organisational visions in a different way,? in which the overcoming of the gender gap represents an example.

The more traditional approaches are incapable of 'handling' situations in which there are strong demands for change and adaptation at every level of the hierarchical scale, including responsibility, empowerment, the role of leaders, overcoming the gender gap and the demand for flexibility in structures (Dolan, Garcia, Diegoli, Auerbach 2000).

The logic of complexity emphasises a broader 'valorisation' of people (Amietta 1998; Padroni 2000) and in order to determine the value attributed to human capital, it is important to orient ourselves towards a prospective dimension, considering monetary and non-monetary aspects that can affect levels of effectiveness and efficiency (Zanda, Lacchini, Orecchio 1993).

In turbulent environments, conditions of self-organisation are important, related to the ability of internal members to freely assume modes of decision-making and behaviour consistent with a mix of shared values (Dolan, Garcia, Diegoli, Auerbach 2000).

According to Padroni, the organisation presents itself as a cognitive system, made up of people who enter into relations with a market-environment trying to

influence value systems and cultures (Gratton 2000), marked by progressive heterogeneity.

It is possible to recall that culture within organisations has a dual function: on the one hand, it integrates the members of the organisation so that they know how to relate to one another and, on the other, it helps the organisation adapt to the external environment.

In the first case, members develop a collective identity by learning how to work effectively, adopting behaviour that is as good and harmonious as possible; in the second case, external adaptation refers to how the organisation achieves its goals and relates to external entities.

Organisational culture can help direct the activities of employees towards the achievement of certain goals and can help the organisation itself respond more quickly to the needs of customers or the moves of competitors.

Corporate values can affect the behaviour of individuals as they represent the general criteria or guiding principles by which people distinguish desirable from undesirable behaviour, events, situations and outcomes.

It can be argued that an organisation's culture performs an internal integration function, in the sense that it helps develop a collective identity, a cultural cohesion, whereby the greater the consensus on the importance attached to specific values, the stronger the culture itself.

A strong culture encourages adaptation and change and can help improve organisational performance by stimulating and motivating interesting individuals.

Culture has an important role to play in creating an organisational climate where learning processes are possible by fostering employee loyalty to the company.

Precisely in support of this aspect, we have insights from the results of a Deloitte survey in which they highlight the factors that contribute to employee retention in an organisation The main ones are:

- Corporate commitment to climate change;
- Commitment to fight hunger and social exclusion;
- Sustainable development;
- Diversity, equity and inclusion widely understood;
- Personalisation in career planning and development;
- Broad learning and development opportunities.

Similar results are also found in research conducted by Innovation Center ProLearning and researchers at the University of Krakow on employees' work expectations:

- A good working atmosphere;
- Being treated with respect;
- Good development opportunities at work;
- Self-fulfilment;
- Corporate values and ethics;
- Trust.

Again, a study conducted by Zenjobs, finds that young German professionals have the following job expectations:

- Strong company values;
- Commitment to diversity, equity and inclusion;
- Sustainable development and environmental protection.Sustainability and Corporate Social Responsibility must, today, be two sides of the same coin, interconnected aspects on which a new business model must be based, within which there can be no creation of value if, in addition to economic performance, its impact on the environmental and social context of reference is not considered.

The gradual emergence of the new paradigm of organisational sustainability responds to the aforementioned need; this latter concept has radically penetrated the operational logic of government bodies, international organisations, and private and public sector institutions.

Organisational sustainability, however, must not neglect the social aspect that this concept encompasses, and gender sustainability is one of its many facets.

The United Nations Women's Turning Promise Into Action report illuminates the issue, stating that sustainable development is not possible without gender equality, as women are disproportionately affected by most, if not all, of the challenges highlighted in the UN's list of seventeen SDGs. One only has to focus on Goal 8 of the 2030 Agenda and recall that, as a result of the Covid-19 pandemic, twice as many women as men lost their jobs in Italy.

Given the relevance of the gender issue, it seems, therefore, crucial to illuminate the critical connection between gender, social equity and environmental impact, in order to arrive at a holistic vision of sustainable development.

3 A quantitative analysis on gender equity

Eurostat notes that European women earn about 16% less than men. In Italy, the difference is 10%, but the figure is misleading, since, given the low employment rate in Italy, there is a selection in the labour market whereby only

the most educated women with higher incomes work. Moreover, in 2018, 32.4 per cent of employed Italian women (15-64 years, Istat) work part-time in contrast to only 8 per cent among men and again according to Istat, 60 per cent of part-time work is involuntary (UNI/PDR, 2022)

Looking then at the individual employment sectors, certainly the industrial and construction sectors are male-dominated, while the instruction, healthcare, catering and artistic activity sectors are equally represented. It turns out, however, that women are employed in the least remunerative sectors, which widens the gender gap in terms of income. The latter gap is also a consequence of the fact that women scarcely hold positions of responsibility and/or managerial positions:

Women in managerial positions in Italy are about 27% (Istat) of the total. The glass ceiling - the obstacles that working women encounter in their career to reach top positions - is still a widespread phenomenon. In managerial positions, gender differences in terms of income are highest, at around 23% (Istat). No less important is the metaphor of the sticky floor - sticky floor - used to make us reflect on the vertical segregation in which women are forced into medium-low and, consequently, lower-paid positions. (UNI/PDR, 2022)

In light of this, it is not surprising that the Covid-19 pandemic has widened this gap. If the financial crisis of 2008 has been dubbed Man cession, given the drastic reduction in male employment, compared to the high number of women who decided to enter the labour market at that time, the economic shock generated by the pandemic has led to talk of a she-cession, given the numbers of women leaving the labour market, in the midst of the pandemic crisis (UNI/PDR, 2022).

The evidence so far points to a discouraging picture, yet many studies note that gender equality is a driver of economic growth and development (Profeta, 2020) No less important then, to point out that more inclusive companies generate higher value.

There is a positive correlation between the presence of women in top positions and corporate performance.

Significant studies conducted in Italy have revealed the positive effect of gender quotas - which have led to an increase in the number of women in decision-making positions - in terms of economic, as well as social, benefits for companies.

Significant European attempts have been undertaken to push national policies in the direction of gender equality, so that they encourage gender equality in both the work and family context, with the aim of breaking down gender stereotypes and sources of inequality.

4 Research question

Driving this research work is an awareness of the enormous gender bias that lurks, historically, in organisational structures, social structures, culture, institutions, values and beliefs. One certainty follows: no effective performance or outcome will be achieved unless we act upstream, starting with our competencies, which are shaped by and reflect the system in which they are acquired. (Spencer and Spencer, 1993).

Starting from these reflections, the paper sets itself the task of conducting a survey on what tools are currently available to Italian companies for a greater valorisation, inclusion of human resources within the company and, in particular, of gender, and the main advantages generated by gender certification and on the motivations that drive companies to become certified.

5 A tool for businesses: advantages and drivers

To answer the research question, we can reflect starting with the document, published by the European Union in 2021, A Union of Equality: The Strategy for Gender Equality 2020-2025.

This sets out key targets and actions to achieve gender equality by 2025 with specific measures to ensure greater gender mainstreaming by 'systematically including a gender perspective at every stage of policy development in all EU policy areas, both internal and external'.

This is combined with the concept of gender mainstreaming, theorised by the European Union, as a process to better understand the causes of gender inequality and identify the most appropriate strategies to combat them. Such processes must be aimed at analysing and verifying the gender impact on each policy undertaken, in order to radically rethink the structures and practices of society, as well as the relationships between men and women and their roles.

Sometimes, initiatives specifically aimed at women are not enough on their own to bring about major changes. The mainstreaming approach questions these policies and the way resources are allocated. And it recognises the correlation between women's relative disadvantages and men's relative advantages. If workplaces are not gender-neutral, any organisation can be far from being considered socially sustainable.

This is why an instrument is needed to facilitate the overcoming of gender inequalities.

A first tool that can be used is the 'Gender Equality Certification System' as an intervention of the National Plan for Recovery and Resilience (PNRR) under the auspices of the Department for Equal Opportunities of the Presidency of the Council of Ministers, aimed at accompanying and incentivising enterprises to adopt adequate policies to reduce the gender gap in all the most critical areas for women's professional growth.

The introduction of a Gender Equality Certification System is part of Mission 5 'Inclusion and Cohesion', Component 1 'Active Labour Policies and Employment Support' of the National Plan for Recovery and Resilience (PNRR) and aims to promote greater inclusion of women in the labour market: an essential tool for improving social and territorial cohesion and of fundamental importance for the economic growth of our country.

Introduced by the PNRR and governed by Law No. 162 of 2021 (Gribaudo Law) and Law No. 234 of 2021 (Budget Law 2022), the Gender Equality Certification System also aims to ensure a higher quality of women's work, promoting transparency on work processes in companies, reducing the 'gender pay gap' (which indicates the difference between the average annual salary received by women and that received by men), increasing opportunities for growth in companies and protecting maternity.

The introduction of this new certification system in our country is facilitated with contributions from the PNRR's Next Generation EU funding for small and medium-sized enterprises and micro-businesses, intended both for technical assistance and accompanying services for certification, and for covering the costs of certification.

The introduction of the Gender Equality Certification System implements the National Strategy for Gender Equality 2021-2026, which aims to achieve, by 2026, a five-point increase in the ranking of the Gender Equality Index drawn up by the European Institute for Gender Equality (EIGE), which currently sees Italy in 14th place among EU countries.

The Gender Equality Certification System envisages the achievement of the following targets and objectives:

- target M5C1-12 Entry into force of the Gender Equality Certification System and related incentive mechanisms for companies by December 2022
- Target M5C1-13 Obtaining gender equality certification by at least 800 enterprises, of which at least 450 are micro, small and medium-sized enterprises by June 2026

- Target M5C1-14 Attainment of gender equality certification by at least 1,000 enterprises accompanied in the certification process through technical assistance provided by contracted consultancy bodies by June 2026.

Pursuant to Article 5, paragraph 2 of Law No. 162 of 5 November 2021 (Gribaudo Law), private companies that are in possession of gender equality certification in application of UNI/PdR 125:2022 practice issued by an accredited certification body are granted an exemption from the payment of a percentage of the total social security contributions to be paid by the employer for the year 2022. Specifically, EUR 50 million are allocated for 2022 and the exemption is determined to be no more than 1 per cent and up to a maximum of EUR 50,000 per year for each company. Article 1, Paragraph 138 of Law No. 234 of 30 December 2021 allocated additional funds to finance the measure when fully operational, providing for 50 million euros starting from 2023.

In addition, again pursuant to the Gribaudo Law (Article 5, paragraph 3), companies that, as of 31 December of the year preceding the reference year, are in possession of gender equality certification in application of UNI/PdR 125:2022 practice, issued by an accredited certification body, are recognised a bonus score for the assessment of project proposals, by national and regional European fund-holding authorities, for the purpose of granting State aid to co-finance the investments made.

Finally, Decree-Law No. 36 of 30 April 2022, on 'Further Urgent Measures for the Implementation of the National Recovery and Resilience Plan', Article 34, introduced in the 'Public Contracts Code', respectively in Articles No. 93 and No. 95 of Legislative Decree No. 50 of 2016, a decrease in the guarantee provided for the participation of certified companies in tender procedures, as well as the possibility for contracting authorities to establish reward systems linked to the possession of gender certification.

The reference practice UNI/PdR 125:2022, published on 16 March 2022 by UNI - Ente italiano di normazione, was developed in order to define criteria, technical prescriptions and functional elements for the certification of gender equality in enterprises.

The UNI/PdR 125:2022 practice envisages the adoption of specific indicators, Key Performance Indicators (KPIs), in relation to 6 assessment areas for the different variables that distinguish an inclusive and gender-equal organisation:

- Culture and strategy
- Governance

- Processes Human Resources
- Opportunities for growth and inclusion of women in the company
- Pay equity by gender
- Protection of parenthood and work-life balance

The culture and strategy area measures the organisation's adherence to the principles and objectives of inclusion, gender equality and attention to gender diversity, so that they are consistent with its vision, goals and values.

The governance area detects the company's maturity in governance: it shall define the appropriate organisational safeguards and encourage the presence of the minority gender in the organisation's policy and control bodies, as well as initiate processes to identify and resolve any cases of non-inclusion.

The Human Resource processes area is aimed at measuring the degree of maturity of the main HR processes, relating to the different steps that characterise the life cycle of a resource in the organisation and which should be based on the principles of inclusion and respect for diversity.

The area of opportunities for growth and inclusion of women in the company detects the company's maturity in relation to gender-neutral access, internal career and growth prospects and their acceleration.

The area of pay equity by gender aims at detecting the degree of maturity of organisations in relation to the pay differential in total reward logic, i.e. also considering non-monetary remuneration, such as welfare and well-being systems.

The area pertaining to the protection of parenthood and work-life balance records the maturity of the company in terms of policies to support parenthood and in relation to the adoption of procedures that simplify and benefit the presence of women with sons and daughters of pre-school age.

Each area is marked by a percentage weight, totalling 100, which contributes to measuring the organisation's current level and against which improvement over time is measured. Each indicator is associated with a score, the attainment or non-attainment of which is weighted by the weight of the assessment area: a minimum total score of 60% is required to determine the organisation's access to certification.

Certification is valid for three years and is subject to annual monitoring.

A first fundamental aspect to be noted for the certification process, in view of a real paradigm shift, is the need to integrate the principles of gender equality and respect for diversity into corporate objectives. It will therefore be important for companies to set precise objectives for each work phase of women within the

organisation, to measure the projects implemented in a standardised way and to certify the results achieved.

Companies will therefore have to commit themselves to incorporating the principles of gender equality, articulated over the entire career path and life stages of female workers, from recruitment to retirement, with the aim not only of increasing the presence of women in the workplace but also of ensuring equal career opportunities, up to the most important top positions, equal economic treatment, work-life balance conditions appropriate to the different life stages and proactive in rebalancing family loads between men and women, as well as a work environment that rejects stereotypes, discrimination, all forms of physical, verbal and digital abuse and instead proposes a culture of diversity and inclusion (UNI/PDR, 2022)

The ultimate goal is to overcome the stereotyped vision of roles, activate the resource of female talent and iron out the criticalities specific to the Italian enterprise, in terms of pay and career, parenting and family care, management bias and management processes.

A strategic and fundamentally important role is played by the measurement of the effectiveness of the actions undertaken by organisations in the field of gender equality and integration through the application of the KPIs belonging to the 6 areas envisaged.

In order to acquire the certification, in fact, each company will have to meet specific performance indicators in six different areas: culture and strategy, governance, HR processes, opportunities for growth and inclusion of women in the company, gender pay equity, protection of parenthood and work-life balance.

Organisations that decide to adopt a corporate gender equality policy, marked by the enhancement and protection of diversity and equal opportunities in the work context, must define an action plan for the implementation of this policy, starting from the setting up of a management model that guarantees the maintenance of the requirements defined and implemented consistently over time and provides for the measurement of the progress of the results, through the preparation of the above-mentioned KPIs to be accounted for in the management system documents

6 Future developments

The purpose of this paper is to conduct a preliminary investigation on the dissemination, among Italian companies, of gender certification and a mapping according to the methodology of cluster analysis.

The research questions to be answered with the mapping of Italian companies are:

- How widespread is gender certification among Italian companies?
- Which sectors and geographical areas are the most sensitive?
- What are the reasons for a company to become certified?

In this way, we will be able to map with greater precision the companies that have certified themselves in order to understand whether the cultural change implemented to overcome the gender gap has brought results within organisational structures.

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Smart Working: A Tool for Social Sustainability from a Gender Perspective

Luca Giraldi*

University of Macerata
Department of Economic and law
62100 Piazza Strambi 1 Macerata, Italy

Maria Zifaro

Universitas Mercatorum
Faculty of Economic
00186, Piazza Mattei 10, Roma, Italy

* *Corresponding author*

Abstract

This academic article discusses the potential of smart working as a social sustainability tool for achieving gender equality in organisations. With the rise of telecommuting and remote work due to technological advancements, companies must adopt a dynamic, innovative mindset open to sudden changes and challenges. Sustainable open innovation is a crucial aspect of fostering sustainability in business operations. Smart working is a recent phenomenon that has gained significant momentum during the Covid-19 pandemic, attributed to its decisive contribution to environmental sustainability. The article explores how smart working can contribute to social sustainability, particularly in the context of gender equality. The research question is whether smart working can become a social sustainability tool for companies to achieve gender equality. The paper aims to explore this issue using resource dependency theory as a key to interpretation. The article employs the case study methodology, which is most suitable for exploring the impacts of gender equity on corporate sustainability. The research highlights the need for more cohesive and consistent literature on the advantages and disadvantages of smart working from an employee perspective. The study indicates that smart working is associated with higher employee participation in company life, higher performance, and greater organisational effectiveness. The paper concludes that trends in remote working will continue after the pandemic and that smart working could be an opportunity for lasting behavioural change to strengthen the positive impact on the environment while achieving gender equality.

Keywords – Smart Working, social sustainability, gender inclusion, diversity management, New Organization

Nature of proposed paper - Practical Paper

1 Literature review

1.1 Gender Gap

Data from the Gender Gap Global Report (2019) and the ISTAT survey (2019) report that while in Europe 20% of women of working age are unemployed, in Italy 32.6% are. The survey mentions, among the reasons, the difficulty in reconciling family life and work commitments and, as a solution, the preference for part-time contracts, flexible working hours and, especially since it has been regulated, smart working. Creating a more inclusive work culture - but also social conditions that are less hostile to the employment of women with disabilities - is, therefore, a necessary prerequisite for moving towards a fairer future. With smart working, the path towards this can be made easier. The diffusion and ease of access to technological tools is changing the systems of communication and interaction of people and between them and different living contexts, favouring social inclusion.

Recent studies demonstrated that SW has empowered subject that were excluded from working space. The transfer of practices and processes to the cloud, the sharing of documents via the web or apps, greater collaboration in online activities, has led to a shift from the physical space of the workplace to a virtual space that makes the scheduling of activities more flexible and makes the working environment more inclusive. This shift has made smartwoking an inclusive tool for individuals normally excluded or marginalised in the world of work, improving the employment of people with disabilities (Samant Raja, 2016; Calvani, 2017; Ravicchio, Repetto and Trentin, 2015). A specific part of the research project 'Ready Women - New opportunities of employment for social inclusion of women with disabilities', financed with funds from the Erasmus+ Programme, Key Action - Cooperation for innovation and the exchange of good practices, Action - KA204, Strategic Partnerships for adult education, was dedicated to the exploration of the use and perceptions related to smart working by women with organic-sensory disabilities.

The development of specific smart working programmes could balance gender and organisational imbalances, provided, however, that the necessary requirements and conditions to implement them are grasped (Doria E. 2021; Zappalà 2017). The Global Gender Gap 2020, in its 14th edition, points to the ICT sector as the one where the great challenge to close the economic gender gap will be played out.

2 Smart working

Smart working (SW) and/or telework, as an organizational practice in the pre-COVID phase (Giraldi L. & Zifaro M., 2022), has become an inescapable strategy to cope with the pandemic emergency. Italian Ministry of Labour and Social Policies report that the smart working mode involved, as of May 2020, 1 million 800 thousand workers compared to 570 thousand in 2019. Smart working refers to a conception of work activity centred on the flexibility and autonomy of the worker rather than on predefined roles and tasks, following an "a-spatial" concept. SW has been identified as an evolution of traditional organisational models, emphasising the need for a competent and flexible workforce that can quickly adapt to new opportunities and market circumstances (Moduli, 2013).

SW is characterised by spatial and temporal flexibility enabled by technological tools that allow workers to perform tasks optimally, which requires rethinking spaces and modes of interaction (Kim & Oh, 2015). The implementation of SW involves the identification of innovative strategic and organisational practices, policies, structures, processes, methodologies, and tools by the organisation itself, requiring a culture change guided by effective leadership, leading to higher performance, increased productivity, and job satisfaction (Iannotta & Meret, 2020; Cuel et al., 2020; Dossena & Mochi, 2020; Viceconte, 2020).

The Smart Worker is an individual who works with information and communication technologies, influencing not only decision-making processes but also the content of work tasks (Moore T., 2020). In this regard, the Smart Worker represents the human component within the Industry 4.0 model (Meindl et al., 2021) and must develop new competencies, including behavioural skills such as time management, the ability to collaborate effectively in virtual teams, self-discipline, proactivity, multitasking, and adaptability (Bednar & Welch, 2019; Dossena & Mochi, 2020; Gangai M., 2018; Richter et al., 2018). Additionally, the Smart Worker must possess or acquire specific knowledge and communication and social skills to interact effectively with geographically dispersed members of the organisation (Bolisani et al., 2020; Park & Han, 2019). The shift from the traditional workplace to the post-pandemic worksphere is part of a de-structured idea of the office that represents a new ecosystem composed by physical and virtual spaces, but also of experiential relationships, linked by an increasingly high-performance technological infrastructure (Pelloni, 2020).

However, the implementation of SW also presents challenges related to social and spatial isolation and a constant availability culture, which could intensify work efforts. Thus, Smart Workers must develop a conscious and reasonable approach

to managing their work commitments and balancing their interests (Taskin & Devos, 2005). Ultimately, the responsibility for achieving work-life balance lies with the individual, who can give significance to new work modalities and develop new trajectories for balancing work and personal life (Doria C., 2021).

With technological advancements, many tasks can be performed remotely or through automation, allowing more flexibility in location and time. This has led to increased telecommuting and remote work and the development of new industries and job roles. Technology has also led to work changes, emphasising digital communication and collaboration tools (Brynjolfsson & McAfee, 2014).

Chesbrough (2003) suggests that companies adopt their business model to open innovation to cope with the increased costs required for the in-house development of new technologies and the shortening of the product life cycle. In this context, organisations must equip themselves with a dynamic, innovative mindset, open to the sudden changes and challenges that the world requires. Companies must ensure they have the right tools to continue creating value. The Covid-19 pandemic has made organisations realise more than ever the importance of Digitisation, a concept already recurring with the spread of Industry 4.0 (Ntasis, 2021).

Smart working was the new way of working for companies during the Covid pandemic (Galanti et al., 2021) and has been attributed to a solid contribution to environmental sustainability (Jain & Singh, 2021). Innovation plays a crucial role in fostering a higher level of sustainability in business operations. Innovations such as smart working that contribute to sustainability are called Sustainable Open Innovation (Battisti & Stoneman, 2010).

3 ICT and gender

A point of attention is about the fact that Italy still ranks 25th among the twenty-eight EU Member States as it has, compared to the average, very low levels of both basic and advanced digital skills, which is linked to the still small number of ICT graduates. Only 1 % of Italian graduates have a degree in ICT disciplines and female ICT specialists account for 1% of the total number of female workers. Consequently, the digitisation of businesses in Italy remains moderate, as does the use of digital public services. A warning to this effect was issued by the OECD in its *Skills Outlook 2019 report*. Globally, only 12% of women are involved in the cloud, 15% are women in engineers working with Big Data and 26% are involved with AI (artificial intelligence). The European Union's Women in Digital Scoreboard report confirms this trend. The ratio of ICT specialists is one

woman to six men who earn almost 20% less than her male counterpart. An essential step, therefore, for SW deployment is the reduction of the digital gender gap, which is among the priorities of the European Commission's Strategy for Gender Equality 2020-2025 as well as the Digital Education Action Plan 2021-2027.

In Italy, the Smart Working Observatory of the School of Management of the Politecnico of Milano has been monitoring SW data since 2012, according to which during 2019 the number of smart-workers grew compared to the previous year to reach a 1050% increase in 2020, reaching 6.58 million workers (97% of private companies, 94% of public administrations and 58% of small and medium-sized enterprises).

About SW, an interesting approach is that of *diversity management* (DM), that promotes an inclusive working environment, which values and protects each of its employees equally by providing resources to learn from, connect with and respect individual differences. In Europe, the American DM logic has been translated into the definition of Diversity Charters aimed at building, at the institutional level, a common reference framework for diversity policies, but also for inclusion and combating inequalities (De Vita 2011; Zifaro 2020).

4 Sustainability

SW includes different goals of 2030 Agenda such as SDG 5 - Achieving gender equality and SDG 11 - Make cities and human settlements inclusive, safe, resilient and sustainable. Economic changes, increasing public awareness, and stricter environmental regulations have driven businesses to adopt more sustainable practices (Lozano et al., 2018).

Sustainability has become a key factor in corporate decision-making, and companies are increasingly adopting sustainable innovation strategies to reduce their environmental impact (Horbach et al., 2017). Smart working was the new way of working for companies during the Covid pandemic (Galanti et al., 2021) and has been attributed to a solid contribution to environmental sustainability (Jain & Singh, 2021). Significant strengths of SW are the lower short- and long-term impact on the environmental pollution problem Innovation plays a crucial role in fostering a higher level of sustainability in business operations. Innovations such as smart working that contribute to sustainability are therefore called Sustainable Open Innovation (Battisti & Stoneman, 2010).

In order to achieve sustainable innovation, businesses can implement various strategies such as eco-design, sustainable production, and waste reduction

(Camarinha-Matos et al., 2018). Additionally, companies can collaborate with external partners such as suppliers, customers, and universities to develop sustainable solutions (Horbach et al., 2017). The benefits of sustainable innovation are numerous and can lead to increased profitability, improved reputation, and a better relationship with stakeholders (Lozano et al., 2018). As such, companies that adopt sustainable innovation strategies can gain a competitive advantage in the market (Horbach et al., 2017).

Overall, sustainability has become a critical issue for businesses, and sustainable innovation is increasingly seen as an effective strategy for reducing environmental impact while increasing profitability. Smart working is just one example of a sustainable innovation that has gained traction in recent years and has the potential to shape the future of work.

As emphasised by several sources, SW contributes significantly to sustainability in all its dimensions, making it an even more exciting approach (Jain & Singh, 2021). Concerning environmental sustainability, the primary advantage is the reduction of commutes for work purposes, which has apparent positive effects on urban pollution. Adopting SW as a "smart" way of organising work also helps reduce everyone's ecological footprint and minimises energy consumption related to workflows and daily office transactions. Furthermore, optimising the use of devices without compromising security or privacy reduces the amount of hardware that will need to be disposed of and recycled in the following years (Galanti et al., 2021). The implications for economic and social sustainability are equally important. The reduction in commuting has effects on the decrease of costs borne by workers and on the recovery of time available, both of which can be reinvested for personal and family needs. From the corporate perspective, reducing the number of people who show up in the office daily optimises space and saves on utilities (Battisti & Stoneman, 2010).

In conclusion, the role of SW in fostering sustainability in business operations is significant. Thus, companies should consider adopting SW to promote sustainability while also obtaining the benefits of increased efficiency and flexibility (Jain & Singh, 2021).

With technological advancements, many tasks can be performed remotely or through automation, allowing more flexibility in location and time. This has led to increased telecommuting and remote work and the development of new industries and job roles. Technology has also led to work changes, emphasising digital communication and collaboration tools.

Chesbrough (2003) suggests that companies adopt their business model to open innovation to cope with the increased costs required for the in-house development of new technologies and the shortening of the product life cycle.

In this context, organisations must equip themselves with a dynamic, innovative mindset, open to the sudden changes and challenges that the world requires. Companies must ensure they have the right tools to continue creating value. The Covid-19 pandemic has made organisations realise more than ever the importance of Digitisation, a concept already recurring with the spread of Industry 4.0 (Ntasis, 2021).

Smart working was the new way of working for companies during the Covid pandemic (Galanti et al., 2021) and has been attributed to a solid contribution to environmental sustainability.

5 Innovation

Innovation plays a crucial role in fostering a higher level of sustainability in business operations. Innovations such as smart working that contribute to sustainability are called Sustainable Open Innovation (Battisti & Stoneman, 2010). Economic changes, increasing complexity and severe environmental problems force companies to change and modify their knowledge management and working methods (Butera, 2020).

Regarding sustainability, especially in the organisational sphere, the environmental aspect is often mainly considered while neglecting the social one. Knowledge plays a crucial role in promoting a higher level of sustainability in business operations. Innovations such as smart working contribute to social sustainability (Carbonara & Pellegrino, 2021). It can be argued that sustainable development is not possible without a systemic and holistic view that also considers gender equality.

Smart working, a relatively recent phenomenon that has spread powerfully, especially with the Covid-19 pandemic, could, in the not-too-distant future, become the new way of working to help achieve full gender equality (Bapuji et al., 2021). It is, therefore, necessary to investigate the correlation between smart working and gender to understand whether it can become a social sustainability tool available to companies for the proper management of knowledge management (Aust et al., 2020).

6 Research

This article attempts to answer the research questions:

> *Can smart working in the wake of the Codiv19 pandemic become a social sustainability tool available to companies to achieve gender equality?*

As a relatively recent phenomenon, there has yet to be much pre-pandemic research on smart working practices and their impact on employee performance and satisfaction. Furthermore, recent literature needs to be more cohesive and consistent on the advantages and disadvantages of smart working (Torre & Sarti, 2019). There is neither much pre-pandemic research on how smart working can become a tool for gender sustainability. Furthermore, recent literature needs to be more cohesive and consistent on the advantages and disadvantages of smart working from an employee perspective.

Studies indicate that smart working is associated with higher employee participation in company life, higher performance, and greater organisational effectiveness (Martin & MacDonnell, 2012).

These aspects are a matter of interest not only in the academic and business worlds. Companies could be incentivised to introduce this way of working in their organisation, not only to meet the needs of employees but also to achieve strategic results in organisational arrangements and gender equality management, as well as to have benefits of environmental and social sustainability a reduction in costs for society.

According to Garanti et al. (2021), trends in remote working will continue after the pandemic and reach sustainable development that facilitates the achievement of gender equality.

With smart working, technological and social systems come together to co-create new value. Doria E. (2021) sees smart working not only as an opportunity for lasting behavioural change to strengthen the positive impact on the environment, where employees feel they are proactively participating in sustainability.

7 Gender equality & social sustainability

The paper aims to explore the specific issue of social sustainability and to understand how efforts to date in gender equality can be facilitated by smart working using Resource Dependency Theory as a key to interpretation. Resource Dependency Theory and Collaborative Innovation considers a firm an open system that depends on contingencies in the business environment, recognizing

the influence of contextual constraints and conditions. This theoretical perspective is helpful for understanding collaborative innovation in enterprises (Gao, Wong, & Lai, 2023).

8 Methodology

The methodology employed in this paper is that of the case study because it is the most suitable for exploring the impacts of gender equity on corporate sustainability and was chosen. A case study is a suitable tool when research aims at exploring certain phenomena within contexts by seeking answers to "how" and "why" questions (Yin, 1994).

The potential of SW as an effective diversity management tool has been highlighted, as its use can support workers with special needs, such as maternity, care of young children or dependent elderly, or illness, as well as permanent needs, such as disability or severe illnesses of oneself or a family member, contributing to creating adequate organisational and professional conditions tailored to them (Samant Raja, 2016; Ravicchio et al., 2015a, 2015b). In this perspective, SW allows the pursuit of reconciliation goals and meets the need to introduce organisational innovations (changing how each work relates to its structure) to improve productivity and efficiency.

However, it is also essential to consider the risks that SW aggravates difficult situations resulting from an unfair distribution of domestic and care work or possible social isolation, as it is not suitable for promoting inclusion and active participation in the work environment as a social and community space (Gentilini & Filosa, 2019).

Despite the limits related to the digital divide and deskilling, SW can act as an instrument of age diversity management, positively intervening in the impact of age on attitudes, behaviours, and performance by rethinking work organisation, training and development, rewarding, and knowledge management (Assolombarda, 2014).

The perception of the quality of work is strongly influenced by the age variable, especially in an era where the workforce in Italy is characterised by a slow generational turnover, mainly in the public sector, where agile work can help reconcile new needs related to the family sphere (the care of elderly and/or sick people) and professional life (the management of the more significant physiological difficulties related to ageing) (Angeletti, 2020).

If shared and built with the "elderly" worker, SW can be considered as a preventive response to the search for work well-being and a form of fight against

age-based discrimination, avoiding early retirement or forced exits from the labour market that increase the risk of depression and cognitive decline (Harper, 2011, pp. 219-231). To ensure that SW qualifies as the optimal solution for workers with disabilities and special needs, targeted interventions must be implemented to reduce risks, such as choices of work reorganisation with attention to sensitive aspects such as the definition of suitable work schedules and conditions (e.g., exemption from night work, provision of suitable private environments), creation of appropriate digital software and hardware infrastructures, promotion and implementation of continuous training aimed primarily at combating digital illiteracy and favouring social inclusion, and definition and application of precautionary and support measures in compliance with the regulatory framework related to health and safety in agile work (Gentilini & Filosa, 2019).

9 Conclusion

Smart Working (SW) has emerged as an alternative to traditional organizational models in recent years. SW is characterized by spatial and temporal flexibility enabled by technological tools that allow workers to perform tasks optimally. This model emphasizes the need for competent, flexible workers who can quickly adapt to new opportunities and market circumstances (Ferreira et al., 2020). Implementing SW involves identifying innovative strategic and organizational practices, policies, structures, processes, methodologies, and tools by the organization itself, requiring a culture change guided by effective leadership (Pereira et al., 2020).

Studies have shown that adopting SW can lead to higher performance, increased productivity, and job satisfaction (Ferreira et al., 2020; Pereira et al., 2020). However, the implementation of SW also presents challenges related to social and spatial isolation and a constant availability culture, which could intensify work efforts (Cacciotti et al., 2021). Smart Workers must develop new competencies, including behavioural skills such as time management, collaboration in virtual teams, self-discipline, proactivity, multitasking, and adaptability (Pereira et al., 2020).

With technological advancements, many tasks can be performed remotely or through automation, allowing more flexibility in location and time. Smart working was the new way of working for companies during the Covid pandemic and has been attributed to a solid contribution to environmental sustainability (Makovi et al., 2021). Innovation plays a crucial role in fostering a higher level of sustainability

in business operations. Innovations such as smart working that contribute to sustainability are called Sustainable Open Innovation (SOI) (Cheng et al., 2020). Overall, sustainability has become a critical issue for businesses, and sustainable innovation is increasingly seen as an effective strategy for reducing environmental impact while increasing profitability (Cheng et al., 2020). Smart working is just one example of a sustainable innovation that has gained traction in recent years and has the potential to shape the future of work.

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The Cultural Dimension of the Board of Directors, like Sex and Age, and its Impact on Firm Value

Anna Turchetta*

Department of Economics and Law
University of Cassino and Southern Lazio
Via S. Angelo, Loc. Folcara, 03043 Cassino, Italy

Sara Gigli

Indipendent scholar

* *Corresponding author*

Abstract

This job has the finality to study the existing relationship between the cultural dimension of the board of directors, like sex and age, and its impact on firm value. It is important to stop and focus on the reason why these two parameters are so important to creation of value inside companies.
The board of directors is the centre where major business decisions are made. The future success or failure of the company depends on the decisions that are made today by directors. The idea of the future companies comes from the board of directors. From here we understand the importance of a deep reading of the mechanisms that govern this organization.
If we analyse the etymological sense of the term "value", we consider everything that is worthy of being taken into account: economic benefits but not only them.
In recent years corporate culture has shown to be a discriminating factor when the economic crisis led companies to exercise resilience actions. The covid-19 first and the international unrest then questioned the way of doing business. The market scenarios, in which companies operate, have changed. One element that made the difference was the mental flexibility of administrators. During these years the company culture has made a difference.
The present work aims to analyse how much the cultural dimension of the boards of directors affects the creation of business value. Particular attention will be paid to Italian companies.
In this article we provide to a review of the most significant papers and texts of the academic research dedicated to the study of human capital-intensive firms. In the field of human capital, the analysis is limited to the culture of women's enterprise. The database that was used for the search is Scopus.
A particular aspect of the cultural dimension that is being studies is the percentage of women sitting on company boards. Specifically, we want to study the correlation, if any, between the value of the company and the percentage of women present in its boards of

directors. We will examine what are the distinguishing characteristics of female management too.
Deepening the scientific literature on the subject of corporate culture and value creation, we want to quantify the value created by the companies under consideration. The goal is to understand if there is a correlation between the percentage of women on the boards and business success, Primary sources and secondary ones will be used in the study.
The analysis was conducted in order to offer a new key to reading these phenomena.

Keywords – Cultural dimension, Firm performance, Decision-making process

Paper type – Academic Research Paper

1 Introduction

Although there is still a long way to go, more and more women are managing to reach the top management. For these reasons it is interesting to analyse what are the main characteristics that it is easy to find within the companies where women sit on the board of directors.

Since the 1970s some authors, mainly of Anglo-American (Schrier, 1975) origin, have begun to conduct research into gender in management and organizations (Paoloni and Demartini, 2016). However, these initial researches saw women in business as something unnatural because their place was at home as mothers and wives (Paoloni and Demartini, 2016). In fact, it took several years to see women reach successful job positions.

Even today, unfortunately, some studies show that there are gender stereotypes yet according to which the role of women in companies must be supportive and not leadership (Claus *et al.*, 2013). Breaking down this wall of prejudice is not easy but small progress is being made in society. Clearly this does not apply to all countries in the world. For example, there are some countries, such as Russia, where regulatory advocacy for women on boards is non-existent. Accordingly, the steps forward to be taken are still many.

In this paper, the characteristics of women enterprises are examined with particular attention to the contribution that women on company boards make to value creation. The field of investigation is represented by the Italian market.

The purpose of the article is to make a bibliographic review that moves in two directions:

1. The literature on "human capital";
2. The literature on the figure of women in top corporate decision-making positions.

A photograph of what is the female corporate reality in Italy today is also given. Taking up the data provided by Unioncamere, Study Center Guglielmo Tagliacarne and Si.Camera's work will develop a comment on the quantitative results of women's businesses.

2 Methodology

In this article we provide to a review of the most significant papers and texts of the academic research dedicated to the study of human capital-intensive firms.

The key elements that have been taken into account are:

- Mappings;
- Categorization;
- Reporting;
- Disclosure;
- Valuations.

From a temporal point of view, the survey is limited to articles published between 1970 and 2022.

In the context of human capital, particular attention is paid to the figure of women on the boards of directors.

The database that was used for the search is Scopus. The data collection phase is about the following steps:

1. Topic choice: the selection of articles started by entering keywords in the Scopus search engine. They were: "human capital" and "female business".
2. Subject area selection: only items within the subject "Business, Management and Accounting" area were chosen.
3. Year of publication: we preferred the most recently publisher articles. Especially on the subject of "female business", all articles prior to 2008 were discarded. This has greatly narrowed the number of sources.
4. Language: the sources used in this article are all written in English or Italian.

Figure one shows the dispersion graph where the two variables are: the date of publication and the number of articles selected. From our sample it can be seen that the attention of scientists on the subject has grown in the last decade. This bodes well for future research.

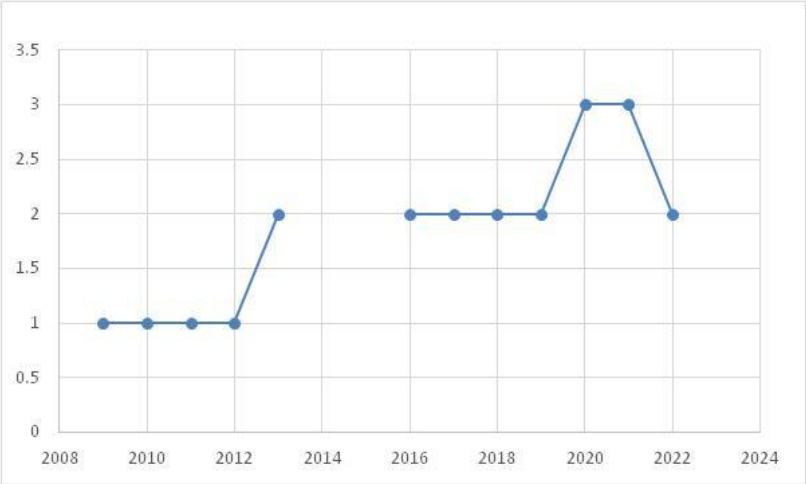

Figure 1. Number of articles published about female business by year
Source: personal processing, April 2023

As for the literature on "human capital", we have noticed a positive scientific production in the twenty years from 1970 to 1990. These articles are interesting as they present the pillars for research on human capital that was carried out in the following years.

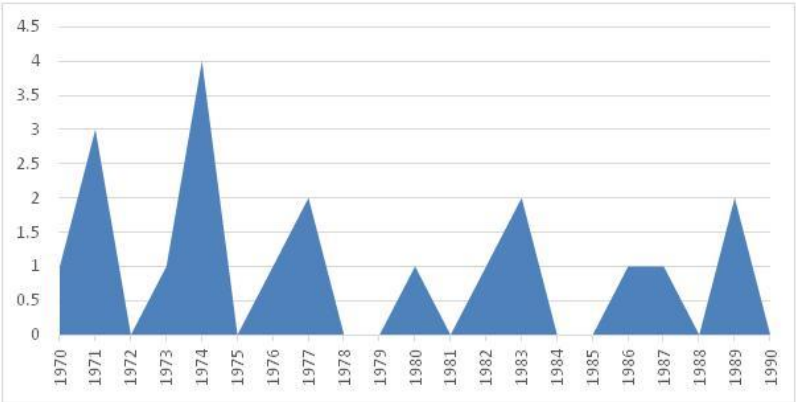

Figure 2: Literature on "human capital", 1970-1990.
Source: personal processing, April 2023

3 Literature review

3.1 The peculiar characteristics of women enterprises and the value of human capital

The value of a company is strongly influences by the human capital or human asset that operates within it. According to the Oxford English Dictionary, human capital can be defined as "the skills the labour force possesses and is regarded as asset".

As early as 1897 Irving Fisher used the term "human capital" and but did not become a serious part of the economists' lingua franca until the late 1950s (Goldin, 2016).

Human capital-intensive firms (HCIFs) are small or large innovative firms "built on specific human capital which is defined as the skills, knowledge and competencies that produce value only within the firm in which it has been accumulated" (Loufrani- Fedida, 2019).

Women enterprises have a cooperative vision of business and relationships are important between people. In fact, some studies show that women are more empathic than males (Li *et al.*, 2022; Eagly and Sczesny, 2009) and this helps to create a network of relationships. The market players with which companies' interface are many and the relationship they have with them is called relational capital. Specifically, the stakeholders with which businesses interface are customers, suppliers, financial institutions and other (Mitchell *et al.*, 1997).

The relational capital is a key factor to create value because helps businesses gain a competitive advantage in the market (Cesarani *et al.*, 2017; Stewart, 1998).

In addition, some research shows that men who have a managerial role in the company are more likely to justify unethical behaviour related to business than women are (Chen *et al.*, 2016).

Inside the non-profit sector in United State of America, women are 45% of the chief executive officers (Claus *et al.*, 2013).

3.2 The creation of business value

The board composition has a key function and it is vital to effectiveness, which in turn directly or indirectly determinates firm performance (Dodd and Zheng, 2022; Hermalin and Weisbach, 1991; Kiel and Nicholson, 2003; Vefeas and Vlittis, 2019).

The board of directors is the place where the supreme strong-willing power is expressed and the underlying addresses of business management are determined (Zanda, 2007).

It has been proven that proclamations of female board appointments affect the market value of the firm making it increase (Campbell and Minguez Vera, 2010). Contrary, there are other studies that show that the positive correlation among female board representation and firm performance is not significant (Kim *et al.*, 2020).

Some studies show that the presence on the board of directors of companies of both men and women is a positive element. In fact, board gender diversity produces a lower pay gap between women and men working in enterprise and improvements in stock price informativeness (Carter *et al.*, 2017; Gul *et al.*, 2011). This leads to an increase of firm value (Greene *et al.*, 2020). Besides board gender diversity enables more effective problem solving (Li *et al.*, 2022).

4 The cultural dimension of Italian companies

The Italian industrial fabric is characterized by the presence of small and medium-sized enterprises, often of a family nature, supported by an entrepreneurial culture frequently not oriented towards growth (Galeotti *et al.*, 2013; Giacomelli and Trento, 2005).

Italian companies are generally small businesses where an important component is relational capital. This term refers to the set of relationships that a company has with its stakeholders like employees, customers, suppliers, banks (Cesarani *et al.*, 2017). Relational capital is a value driver (Cosentino and Paoloni, 2021).

In 1934 Maria Magnetti was the first woman to be elected to a board of directors in Italy (Guglielmetti, 2012; Gamba and Goldstein, 2009). She was elected in the Paramatti.

According to a study conducted by Gamba and Goldstein, there were less women in boards in Italy than in other OECD countries, like France, Germany and United States. From the data collection it can be seen that while in 1962 there were only 13 women (0.6%) on the boards of directors, in 2007 they became 291 (6.7%) (Drago *et al.*, 2012). This shows that the trend is growing but the development has taken a long time and still today there is a lot to do.

A study conducted by Paoloni and Modaffari shows that in Italy there are 554 female startups where "the arithmetic average among the women present in the

company's share capital and the percentage of chair ownership in the administrative body exceeds 66%" (Paoloni and Modaffari, 2018).

How do you read in the V Unioncamere Report on female entrepreneurship presented in July 2022, in Italy there are more than one million women's businesses, equal to 22% of a total of 6 million companies active in the national territory. Women entrepreneurs in Italy are now younger and especially more attentive to the socio-environmental impact of their businesses. According to the 2017 Asvis Report, the lack of adequate social services to support women and an insufficient support to motherhood and paternity cause 30% of mothers who have a job to interrupt it at the birth of the son.

As Table 3 shows, most female businesses operate in the service sector (71%). However, it is worth highlighting that in the industry, in 2021 (compared to 2020) there is an increase in female enterprises of more than 600 units compared to a sharp decrease in non-female enterprises (Unioncamere - Study Center Guglielmo Tagliacarne - Si.Camera "V National Report on women's entrepreneurship").

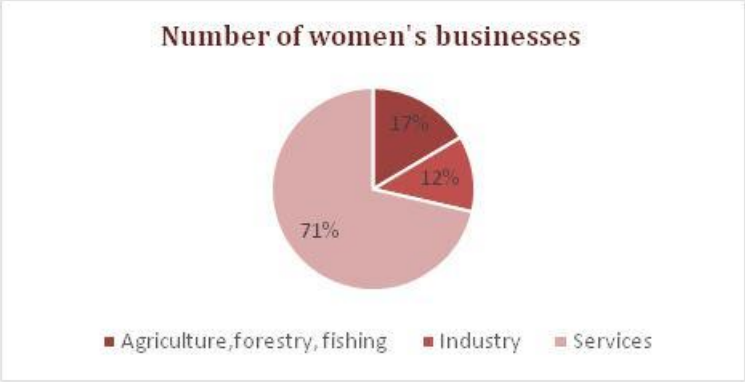

Figure 3 Women's entrepreneurship sectors in Italy
Reference: Unioncamere - Study Center Guglielmo Tagliacarne - Si.Camera (2022) "V National Report on women's entrepreneurship".

Relative to size, 96.7% of women's businesses have a micro size, 3.1% have a small size and 0.3% medium-large (Unioncamere - Study Center Guglielmo Tagliacarne - Si.Camera).

From a geographical viewpoint, the data provided by the Fifth National Report by Unioncamere, Study Center Guglielmo Tagliacarne and Si.Camere, show that the area where there is a greater concentration of women's businesses is southern Italy. The high rate of female unemployment in those territories could be one of the reasons why young women create new entrepreneurial projects from scratch.

However, beyond the trend, in 2021 Lombardy is the Region of Italy with the largest number of female companies representing more than 36% of the national total.

The recent pandemic crisis that has invested Italy among the many countries has also shown that although small, female businesses are very strong. The attitude to change, the ability to promote new initiatives and the ability to have initiated, consolidated, and managed solid formal relationships with institutional stakeholders are skills of female manager that make businesses more resilient (Cosentino and Paoloni, 2021).

5 Conclusions and further research topics

In a globalised market like the one in which companies operate today, the cultural dimension of the board of directors plays a central role. The future success of business depends on the choices that managers take today. For these reasons it is very interesting and current to deepen these issues. A further effect of globalisation is the presence of people from different nationalities and with different cultures on the same board of directors (Dodd and Zheng, 2022).

The culture is defined as "the collective programming of the mind which distinguishes the members of one human group from another" (Baatour and Ben Saada, 2022; Hofstede, 1980).

The purpose of this work is to provide a review of the most significant papers and texts of the academic research dedicated to the study of human capital-intensive firms (HCIFs) in relation to a series of analysis drivers that are explained below in the period 1970-2022.

In the field of human capital, the analysis is limited to the culture of women's enterprise.

On the basis of the following analysis and the identification of the keywords of the research, the most significant contributions were identified in relation to some paths which are identified below:

- Mappings;
- Categorization;
- Reporting;
- Disclosure;
- Valuations.

An attempt has been made to find a driver of a transversal nature in the context of identifying a path aimed at "explaining" the process of value creation

through human capital understood as seed financing of the broader concept of intellectual capital.

The theme of valorisation and non-financial Disclosure encompass the meaning and purpose of the informative value of human capital in terms of the competitive advantage of companies with a high cognitive intensity.

The issue therefore arises of identifying value drivers that must be appropriately valued also in relation to the contents of the non-financial disclosure.

The drivers of value from the qualitative analysis that emerge are those related to the development of human resources, the risk rate of innovation policies and the contribution of human capital to the rate of development of company size and value.

In particular, the theme of external networking emerges clearly as a tool for sharing knowledge to create additional and incremental knowledge.

The theme of the internal network also appears to be of vital importance, for which the result is expressed as a result of the processes of transfer of knowledge and corporate culture that feed the conditions of business continuity.

Two aspects emerged from the bibliographical and empirical research on the female enterprise:

1. A considerable increase in scientific production on the subject from the current century;
2. An uphill trend on the development of women's businesses in Italy.

This work is just a first step on a research stand that presents interesting food for thought.

In conclusion, it is possible to believe that gender research can lead to the identification of the presence of some transversal drivers which in the literature can allow the qualification of the relationship that exists between the cultural dimension and gender policies in high-performing enterprises cognitive intensity.

The analysis of the literature allows us to identify five transversal drivers whose presence leads to the creation of value within a cultural dimension

The next research steps are on the appreciation of a multivariate linear regression on non-financial disclosure topics and firm performance to investigate how the fine transversal driver can increase financial performance and improve the book and the market value of the firm highly based on knowledge and manager reputation.

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Blockchain Technology for Secure Management and Traceability of Industrial Data: A Bibliometric Analysis

Angelo Corallo

Department of Engineering for Innovation
University of Salento
Lecce 73100 - Campus Ecotekne, via Monteroni

Vito Del Vecchio

Department of Engineering for Innovation
University of Salento
Lecce 73100 - Campus Ecotekne, via Monteroni

Marianna Lezzi*

Department of Engineering for Innovation
University of Salento
Lecce 73100 - Campus Ecotekne, via Monteroni

* *Corresponding author*

Abstract

Blockchain is recognised as a useful key digital technology in Industrial Internet of Things environments. It provides a means for the protection, traceability and security of industrial data. Blockchain is defined as an immutable digital ledger technology, based on a distributed and decentralized infrastructure that facilitates the management of data and transactions by leveraging on encrypted and trusted mechanisms. Despite it was introduced in 2009, it seems to be still immature. Indeed, some few applications have been experimented since 2019. Therefore, it is interesting to explore the knowledge boundaries of such technology for a secure data management and for ensuring the sustainability of industrial business models. Based on a systematic literature review and a bibliometric analysis, this study aims to identify the most important implications of the blockchain adoption with regard the protection and traceability of data in industry. The results of the analysis show the identification of seven clusters, as potential future research directions. The study provides both theoretical and practical implications. It extends the body of the literature by suggesting potential opportunities in industry and within an emerging technological field. Also, it supports managers to identify and plan accurate strategies for strengthening the sustainability of their business, by leveraging on the development of novel knowledge for a secure management of their assets.

Keywords – Blockchain, Data protection, IIoT, Bibliometric analysis, Research directions

Paper type – Academic Research Paper

1 Introduction

The Industrial Internet of Things (IIoT) era - also known as Industry 4.0 - is characterised by multiple emerging technologies, including Blockchain (Corallo et al., 2022). It gains significant importance from both scholars and practitioners in terms of applicability and benefits for the business (Joshi et al., 2022). Indeed, the blockchain can be defined as an immutable digital ledger technology, based on a distributed and decentralized infrastructure, that facilitates the management of data and transactions by leveraging on encrypted and trusted mechanisms (Bhujade et al., 2021; Damoska Sekuloska and Erceg, 2022). It has attracted considerable attention for its ability to provide security, privacy and traceability of systems, as well as data, within industrial contexts (Leal et al., 2021). In fact, a strong relationship exists between blockchain and data protection and traceability in industry (Liang et al., 2019). According to (Gartner, 2023), the business value generated by such technology will grow rapidly, reaching $176 billion by 2025 and $3.1 trillion by 2030. However, despite the blockchain is promising in terms of immutability, reliability, complete transparency, anonymity, integrity and security of transactions, without involving any third-party organizations (Yli-Huumo et al., 2016), unlike other digital technologies, it seems to be still immature (Radanović and Likić, 2018). Compared to centralised models, the decentralised architectures that characterise the blockchain technology (BCT) have the potential to dramatically expand the scalability of existing industrial internet solutions, while ensuring the security and privacy of network participants (Sahoo, 2019). Few studies have been provided in the literature that focus on the role of blockchain and its implications for data protection and traceability in industrial contexts. For instance, (Joshi et al., 2022) described the BCT without detailing its components or offering any suggestions about existing security solutions. Also, (Alladi et al., 2019) focused on defining different blockchain applications within Industry 4.0, but overlooking the technological impacts. In addition, (Andoni et al., 2019; Zoughalian et al., 2022) explored some applications in specific target areas, but their studies lack of generalizability.

It is crucial to understand the implications of blockchain adoption for a secure data management and for ensuring the sustainability of industrial business models. It is therefore insightful to intersect such fields in order to identify their knowledge boundaries (Tranfield et al., 2003). Considering such issues, based on a

systematic literature review and a bibliometric analysis, this study aims to identify the most important emerging research directions related to the application of BCT in industry with regard to data protection and traceability, in order to reflect on and understand the most important intersection points and implications. In particular, this study aims to provide an answer to the following research question: What are the implications of applying BCT for industrial data protection and traceability? In order to answer this research question, a network analysis and graphical investigation of the textual data with the aim of creating a co-occurrence map is carried out, using the Scopus scientific database and the VOSviewer bibliometric analysis software.

The results of the analysis show the identification of seven clusters (i.e., secure digital industry, secure data management, protection mechanisms, decentralised and distributed architecture, security as a service, resilient security solutions, data manipulation techniques) as potential research directions for understanding the implications of BCT in the area of data protection and traceability.

The study provides both theoretical and practical implications. It extends the knowledge boundaries through the formulation of potential future research directions in industry and within an emerging technological field. Also, it supports managers in understanding useful strategies for strengthening the sustainability of their business, by planning the use of BCT and leveraging on the development of novel knowledge for a secure management of their business assets.

The remainder of this paper is organized as follows. Section 2 provides a literature overview about BCT and its applications for industrial data protection and traceability. Section 3 describes the methodology adopted by researchers and section 4 highlights the results of the exploratory study. Finally, section 5 concludes the paper by discussing key findings and research limitations.

2 Background

2.1 BCT applications

Blockchain technology was initially introduced in 2009 to enable the use of digital currency (Bitcoin) through a dedicated platform, but was soon implemented in many other applications, including those related to the industrial world and, specifically, the manufacturing industry (Mohamed and Al-Jaroodi, 2019).

The blockchain is a distributed and ever-growing list (or chain) of concatenated data records, called blocks, which are protected through the use of cryptographic

algorithms (Zyskind et al., 2015). Two key elements underlying the effectiveness of such a list can be distinguished. The first element is related to the consensus required between the participating entities when adding a block; the second element depends on the links that are created between one block and the next, which make it difficult to change any block once it has been added to the list. In this context, an entity represents any actor involved in a transaction that needs to be validated and recorded; it can be a person, a group of people, an organization or a computing component (e.g., robot, intelligent device, sensor, control device). On the other hand, a transaction is a record of the activity that is performed (whether financial, commercial, industrial or system-related); whereas, the list is a protected online register where certain transactions agreed upon and performed between different entities are recorded. Finally, the blocks, which store transactions, are usually timestamped, encrypted and replicated across multiple sites, and cannot be altered. This makes the security architecture underlying the blockchain robust and ensures data integrity and privacy (Bodkhe et al., 2020).

The structure of the BCT is divided into five layers (Guo et al., 2020; Yin et al., 2021). The *data layer* is the lowest layer of the blockchain architecture; it is used to store data and ensure their security. Specifically, this layer decrypts data in a decentralized manner with common algorithms and technologies (e.g., the hash algorithm and asymmetric cryptography). The *network layer* is instead a Peer-to-peer (P2P) network, where each node stores all transaction records in the form of a blockchain. This network uses distributed storage technology and each node stores a copy of the complete data. Furthermore, the *consensus layer* hosts the consensus mechanism necessary to enable the management of blockchain data by all participating nodes. Currently, the mainstream consensus algorithm mainly includes Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS), Practical Byzantine Fault Tolerance (PBFT) (Andoni et al., 2019). Another layer is the *contract layer*, which contains various types of smart contracts (SC), consisting of different types of script code and algorithms (Pan et al., 2022) . Finally, there is the most superficial state, which contains the *applications layer*, in which practical applications of blockchain, such as those related to the financial or health industry, are found.

Blockchain applications are often characterised by the need for disintermediation and decentralization (Uddin et al., 2021). According to (Tan et al., 2021), disintermediation is "the power of removing intermediaries in the distribution network"; while, (Carmo Farinha et al., 2015) define decentralization as "the process of redefining and redistributing responsibilities, functions, and

decision-making power within an organization so that stakeholder participation is more equitable and all power is not delegated to a central authority". Since blockchain can guarantee reliable transactions between two unknown parties, eliminating the involvement of third parties, a large number of applications of this technology can be found in various sectors. In addition to the well-known financial field of application, another use of BCT is in asset management, which allows the history of assets to be tracked and their details to be stored efficiently (Thakker et al., 2021). BCT is also used in the healthcare sector for processing confidential medical data (Zhu et al., 2020). Furthermore, a strong expansion of the application of BCT has occurred in the pharmaceutical sector. Specifically, in this area, its application is aimed at drug supply chain management, drug quality assurance, and prevention of drug counterfeiting (Zoughalian et al., 2022). BCT is also widely used in the energy sector, mainly to secure distributed power grids (otherwise easily hacked by malicious users) (Wei et al., 2020). Moreover, the application of BCT is rapidly spreading in the food safety sector. Through its use, food chains are being tracked, verifying the origin of the product, its quality and that it reaches the recipient directly (Damoska Sekuloska and Erceg, 2022). Blockchain is also being discussed in the government sector, where this technology could make services more efficient and transparent. Through the authentication of access, in fact, it will make it possible to request documents in real time, without undergoing bureaucratic procedures (Lahbib et al., 2021). A further area where the use of blockchain is growing strongly is the technology sector. Here, its use enables device access control and efficient data management (Qi et al., 2021). Furthermore, applications of BCT are known in the context of smart manufacturing, i.e. in the field of product lifecycle management (PLM). In this context, the implementation of BCT enables increased data security and traceability, automated transactions and decentralised consensus (Chen et al., 2022). Finally, the study conducted by (Alladi et al., 2019) mentions the drone, education, copyright, taxi, agriculture, and e-commerce and retail services sectors as new fields of application for BCT.

2.2 BCT for industrial data protection and traceability

Since the first implementation of blockchain as a public ledger for cryptocurrencies, BCT has evolved to create immutable systems that meet several criteria, such as reliability, anonymity, transparency, traceability and, in general, a high level of security (Golosova and Romanovs, 2018; Baygin et al., 2019). Thanks to these properties, blockchain has become an implementable technology in the

context of Industrial Internet of Things and in particular in the field of the smart manufacturing (Yu et al., 2021). In fact, the blockchain is a distributed, traceable and tamper-proof ledger (Bhujade et al., 2021). In particular, its nodes share data and jointly maintain the ledger, as well as using consensus mechanisms to ensure data consistency. On the other hand, the encryption techniques used by the blockchain ensure secure data sharing between authorized users. Moreover, blockchain is more performant than cloud platforms and databases in general, in terms of tamper-proofing, privacy protection, and temporal ordering (Cheng et al., 2019). In fact, the immutability and traceability features of the blockchain enable it to guarantee the secure storage of data.

In the context of IIoT and in the specific field of smart manufacturing, a certain number of blockchain-based frameworks have been defined to ensure the security and traceability of industrial data. The Compressed and Private Data Sharing (CPDS) framework, proposed by (Qi et al., 2021), allows for data authentication, data access control, and a high level of data management efficiency. Three industrial entities operate within the CPDS, namely: industrial participants, who process products and send product data to the blockchain; third-party users, who read product data from the blockchain; and access control managers, who define access policies to product data and assign keys to users. Moreover, (Lahbib et al., 2021) propose the privacy-preserving distributed access management framework (PDAMF), which utilises the Ethereum blockchain platform for the management and utilisation of shared resources between collaborating parties and resource access permissions. In particular, the PDAMF ensures: i) untraceability, whereby it is impossible to trace who requests access and under what conditions such access is granted; ii) unlinkability, which makes it impossible to prove that transactions are sent from a specific sender or to prove the sender's real identity; and iii) confidentiality policies, whereby sensitive access control policies are to be disclosed only to authorised parties.

On the other hand, referring to the specific area of smart manufacturing, the framework proposed by (Chen et al., 2022) is applied in the context of PLM to address the challenges of multi-party data management and data security. This framework considers the application of blockchain in four different PLM scenarios, such as: (i) product design, (ii) product manufacturing, (iii) product utilisation and (iv) product recycling. Furthermore, (Lin et al., 2021) developed a blockchain-based life cycle assessment (BC-LCA) framework, in which blockchain technology is implemented to secure and transmit inventory data from suppliers to manufacturers. Specifically, with the BC-LCA framework, more specific data can be

collected along the supply chain in real time, while improving the availability, accuracy, privacy and automatic updating of inventory data. Finally, (Ugochukwu et al., 2022) proposed a blockchain-based framework for an efficient logistics management system (named BFSELMS). The aim of BFSELMS is to provide secure transactions between supply chain actors through the integration of smart contracts into IoT systems. This framework aims to support for IoT devices, privacy and security for customer and product information, and efficiency in the execution of logistics processes.

3 Methodology

To understand the implications of using the BCT for industrial data protection and traceability, it is useful to combine these fields of interest. Indeed, the paper aims to identify the knowledge boundaries (Tranfield et al., 2003) between BCT and industrial data protection and traceability, in the attempt to provide an answer to the aforementioned research question: What are the implications of applying BCT for industrial data protection and traceability?

A systematic literature review (SLR) has been considered as the reference methodology for collecting the sample of data. The SLR is a relevant process applied in different research areas, such as the innovation management research (Snyder, 2019). It can be defined as a transparent, scientific and replicable process that allows for the identification, highlighting and evaluation of several sources of information in order to catalogue and compare the results in a structured way (Bell et al., 2022; Corallo et al., 2023). It needs an iterative process with multiple steps and, therefore, a structured methodology is recommended. On the other hand, a bibliometric analysis has been carried out to analyse such data sample and provide an exploratory understanding of these emerging fields. Indeed, the bibliometric analysis is recognised as a fundamental methodology for exploring research of any disciplines and areas and highlight their nature (Donthu et al., 2021).

As also suggested by (Corallo et al., 2019; Del Vecchio and Menegoli, 2023), three main phases comprised the reference methodology of this study: i) definition of search schema and data sample; ii) preliminary analysis of the sample; iii) data analysis. Figure 6 details steps and sub-steps of the methodology.

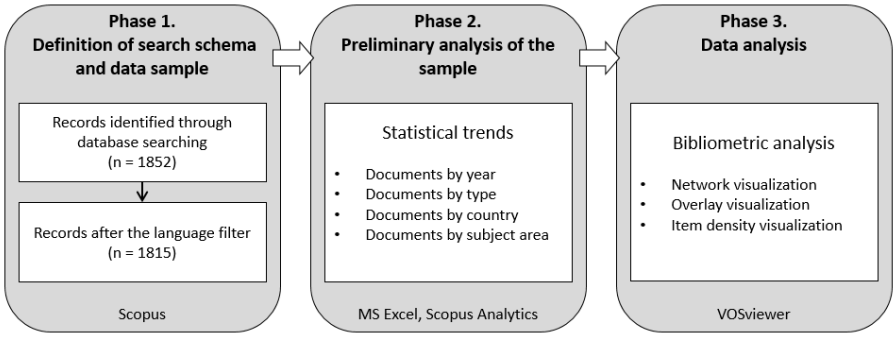

Figure 6. Steps of the research methodology

3.1 Definition of search schema and data sample

In line with the objective of this study and considering the SLR procedure (Corallo et al., 2023), the following keywords were selected for the investigation of the fields of interest:

- "Blockchain", "Block chain", "BCT", "Decentralized database", "Distributed ledger", "DLT", "Smart contract", "Consensus algorithm";
- "Data security", "Data protection", "Privacy", "Data insurance", "Information security", "Security of data", "Protection of data";
- "Traceability", "Trac* data", "Traceability links", "Traceability systems";
- "Industrial Internet of Things", "IIoT", "Industrial Internet", "Industry 4.0", "Smart factory", "Smart Manufacturing".

The selection of these keywords comes from the consideration of similar concepts and synonyms observed in the theoretical background. In particular, while the first group of keywords refers to the BCT, the second one includes the concept of data protection, the third one encompasses key terms related to data traceability, and the last one contextualises the investigation in the industrial sector. Specifically, a combination of these keywords has been implemented by using accurate mathematical logical connectives (Boolean operators). Also, to build a homogeneous data sample useful for the following bibliometric analysis, the language filter has been used to considered only contributions written in English. Below, the designed query:

("Blockchain" OR "Block chain" OR "BCT" OR "Decentralized database" OR "Distributed ledger" OR "DLT" OR "Smart contract" OR "Consensus algorithm") AND ("Industrial Internet of Things" OR "IIoT" OR "Industrial Internet" OR "Industry 4.0" OR "Smart factory" OR "Smart Manufacturing") AND ("Data security" OR "Data protection" OR "Privacy" OR "Data insurance" OR "Information security" OR "Security of data" OR "Protection of data") AND ("Traceability" OR

"Trac* data" OR "Traceability links" OR "Traceability systems") AND (LIMIT-TO (LANGUAGE,"English"))

Papers containing such terms in their title, abstract and keywords, have been searched (in April 2023) into Scopus (www.scopus.com), an important electronic scientific database, recommended as a robust source of data.

According to the selection criteria (

Table 1), the initial sample of 1852 papers was refined up to 1815, due to the language filter. The results have been exported in csv and txt files, storing all the information necessary to provide next analysis (e.g., title, authors, affiliation, abstract, keywords).

Table 1. Selection criteria

Criteria	Motivation
The paper must contains the selected keywords.	Because this study aims to investigate the intersection points of the fields of interest.
The paper must be written in English.	Because the bibliometric analysis is facilitated if a homogeneous set of terms refers to the same language.

3.2 Preliminary analysis of the sample

The second step of the methodology focused on analysing the statistical trends of the literature contributions. MS Excel and Scopus Analytics have been used for the analysis of the sample.

Figure 7 shows the trend in quantity of papers published over the years. As expected, it is interesting to observe that the conjunction of the BCT field with data protection and traceability starts to be significant only in the last years. Indeed, an increasing attention of both academics and practitioners can be proven only from 2019, with an approximated tax of production grown of 280%. Indeed, as also confirmed in the literature (Radanović and Likić, 2018), BCT resulted to be still immature before 2018 and some applications appeared only recently.

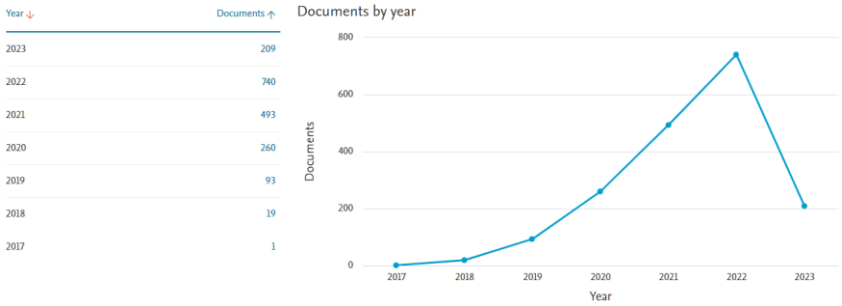

Figure 7. Publishing trend of papers over the years

In addition, according to Scopus classification, out of 1815 documents, 63.1% represents journal articles, 16% are conference articles, 14.5% are review and 5.1% are book chapters (Figure 8).

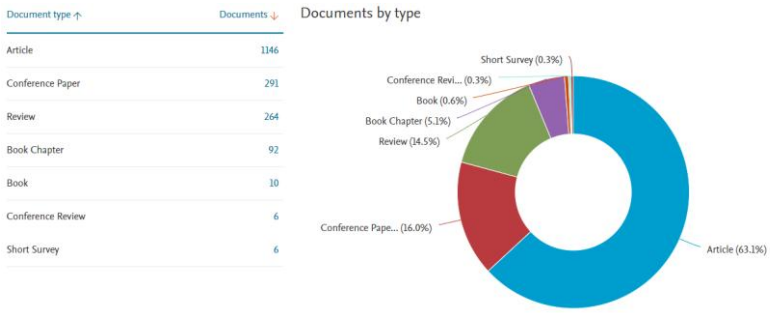

Figure 8. Document types distribution

The interest towards these fields and their relationship comes from all over the world (Figure 9). In fact, the top five countries that provided such studies are: China (528 papers), India (385), United States (194), United Kingdom (169), Australia (138). Italy appears at the seventh position with 78 papers. This view can be also interpreted as the diffusion trend of the interest in many different economies.

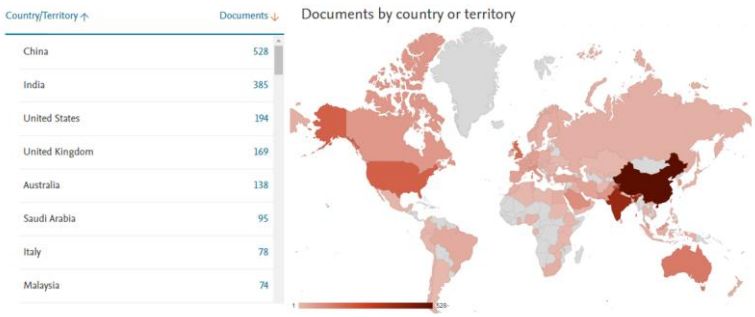

Figure 9. Distribution of papers around the globe

Finally, Figure 10 shows that there are several research areas that addressed the attention on BCT for data protection and traceability. Particularly, the most important areas are represented by technical sources: "computer science" (30.2%), "engineering" (22.3%), "business, management and accounting" (8.1%), "decision sciences" (6.8%), "mathematics" (4.7%).

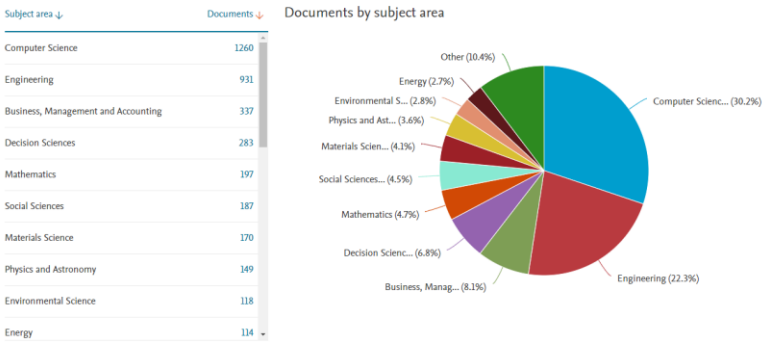

Figure 10. Distribution of papers around the globe

3.3 Data analysis

The third and last phase of the methodology focused on analysing the total amount of 1815 documents by carrying out a bibliometric analysis. This approach has been applied over the time in many research studies, such as business strategy (Kumar et al., 2021) and business management (Ellegaard and Wallin, 2015). Such analysis is useful for a macro assessment of the most relevant topics related to the research fields, thus helping, in this study, in defining the boundaries of knowledge of BCT and data protection and traceability. Therefore, the bibliometric analysis has been applied to: i) understand the most recurrent topics that surround the fields of analysis; ii) identify their relationships; iii) underline emerging topics and trends over the time. A network analysis and graphical investigation on text data have been carried out in order to create a co-occurrence map by using VOSviewer software. Such tool focuses on the graphical representation of bibliometric terms, functionally useful for displaying large maps in an easy-to-interpret way (Hu et al., 2019; van Oorschot et al., 2018). The analysis has been conducted following the suggestions provided by (Donthu et al., 2021; Fahimnia et al., 2015).

The analysis has been based on counting the recurring terms in "title" and "abstract" with a minimal frequency of 10. Out of 9087 terms, 297 meet the threshold. The following section shows a qualitative analysis.

4 BCT and Industrial Data Protection and Traceability: Implications as Future Research Directions

To analyse whether the BCT has implications on data protection and traceability, the bibliometric analysis revealed a useful tool for a general understanding. Particularly, the bibliometric analysis allowed for carrying out a network analysis based on term co-occurrence. As suggested by (Sternitzke and Bergmann, 2009), it is probable that documents that refer to many common documents deal with a similar theme and, contrarily to other techniques, such as co-citation analysis that connects articles based on the received citations, term co-occurrence aims at identifying the research front, that is, the historic trends.

The bibliometric analysis returned the co-occurrence map illustrated in Figure 11, which encompasses seven clusters of terms. Each recurring term identifies a node of the network that can be in relationship not only with other nodes of the same cluster, but also with those of other clusters. The node size is the mirror of the occurrence of the term, so, the larger the nodes, the more frequent the terms in the pool of analysis. Moreover, the centrality of the nodes is representative of the relevance for the cluster and for the overall network as well. The link between two nodes means that those terms are included in the same article, and the thickness is proportional to the number of times they are used.

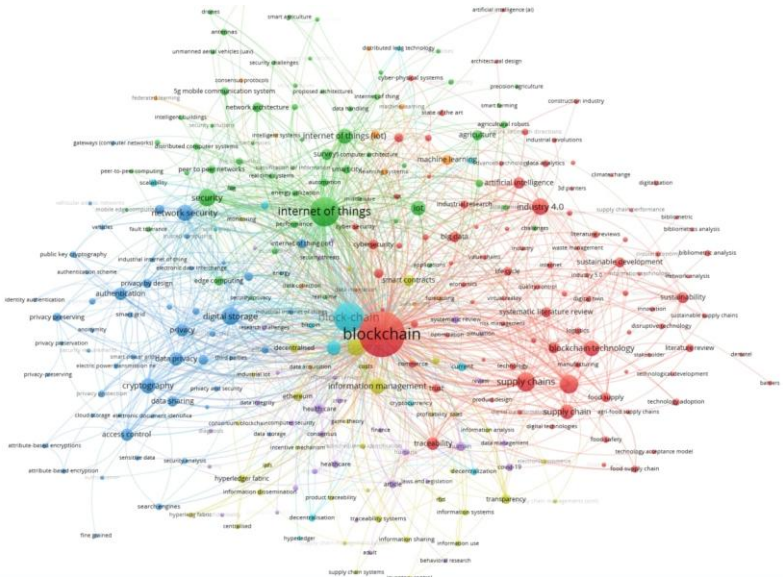

Figure 11. Network visualization

The co-occurrence analysis highlighted seven clusters, which are identified by different colours:

- Cluster 1 (red) is composed of 93 terms (e.g., blockchain, cybersecurity, artificial intelligence, big data, data analytics, virtual reality, digital twin, cyber physical systems, Industry 4.0, Industry 5.0, smart manufacturing, supply chain management, traceability, sustainability, trust, security of data) referred to the "secure digital industry" topic, in which the BCT is an enabler of the digital transformation in modern industrial contexts for data security and traceability.
- Cluster 2 (green) is composed of 58 terms (e.g., Internet of Things, security, quality of service, edge computing, network architecture, distributed computer systems, fog computing, automation, peer-to-peer network, data handling, data transfer, integration) referred to the "secure data management" topic, as the need to manage data, from its acquisition to storage and use, in a secure way.
- Cluster 3 (blue) is composed of 53 terms (e.g., digital storage, network security, authentication, authorization, hush functions, cryptography, privacy by design, data security, data sharing, access control, trusted computing, security systems) referred to the "protection mechanisms" topic, as actions for empowering privacy preserving and cybersecurity mechanisms in industrial contexts.
- Cluster 4 (yellow) is composed of 36 terms (e.g., information management, decentralised, hyperledger fabric, ethereum, smart contracts, information systems, traceability systems, product traceability, interoperability, profitability, transparency) referred to the "decentralised and distributed architecture" topic, as a functional feature for secure management of transactions between multiple nodes in a network.
- Cluster 5 (purple) is composed of 31 terms (e.g., computer security, algorithm, data integrity, confidentiality, centralized systems, information services, consensus, information security, data management) referred to the "security as a service" topic, as the configuration of digital services of security for industrial users.
- Cluster 6 (light blue) is composed of 13 terms (e.g., scalability, hyperledger, distributed ledger, decentralization, consensus algorithm) referred to the "resilient security solutions" topic, as flexible and robust systems for assisting industrial users in ensuring data security.

- Cluster 7 (orange) is composed of 13 terms (e.g., data acquisition, data collection, data integration, data mining, deep learning, federated learning, forecasting, intelligent systems, learning algorithms, machine learning) referred to the "data manipulation techniques" topic, as a set of procedures to handle industrial data in blockchain-based architectures.

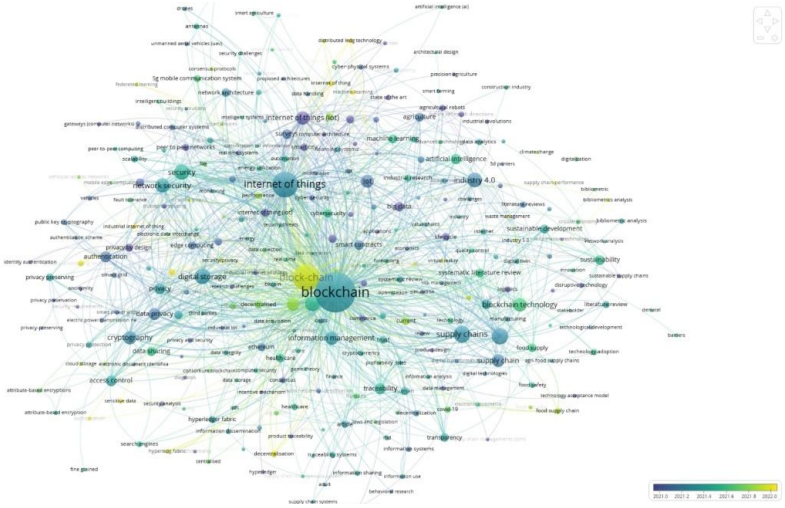

Figure 12. Overlay visualization

Furthermore, Figure 12 shows the overlay visualization of the term co-occurrence. It represents the same network map visualization, but within the temporal dimension, through the use of different colours (as shown in the colour bar in the bottom right corner of the figure). The colour represents the average year in which the terms appear. While older terms are in blue, recent terms are in yellow, and terms in the middle are in green. To observe a significant difference of colours, the temporal range of reference spans from 2021 to 2022. Indeed, before and after such years, no relevant differences could be observed. It is interesting to note that, most recently, the following main terms appear: block-chain, decentralisation, hyperledger fabric, authorization, sensitive data, authentication, industrial internet of things, machine learning, cloud computing, accident prevention, virtual reality, supply chain performance. On the contrary, older terms include: privacy by design, big data, lifecycle, embedded systems, internet of things, logistics, security of data, commerce, consensus, architecture, diagnosis. In the middle, it is possible to find these terms: digital storage, privacy, cryptography, network security, information management, data handling, data

sharing, sustainability, artificial intelligence, scalability, transparency, trust, security.

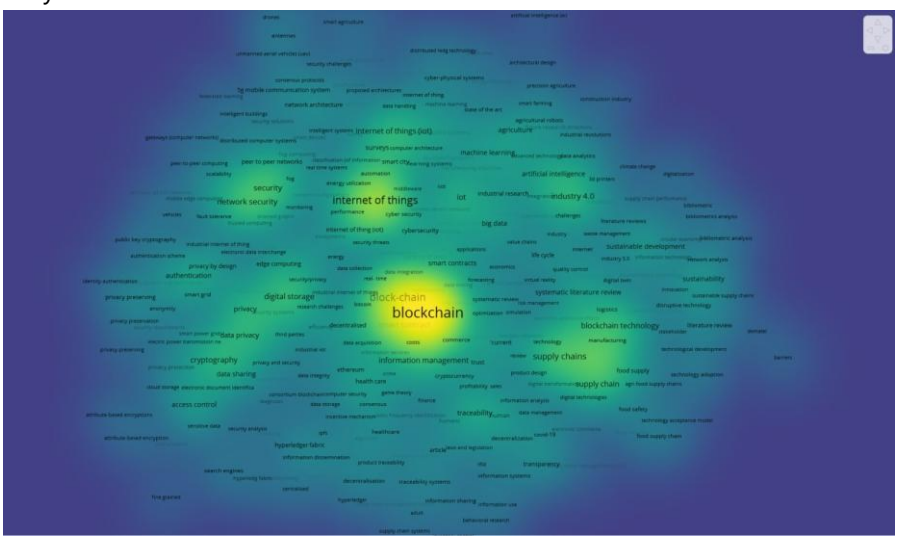

Figure 13. Item density visualization

Finally, in Figure 13, items are represented by their label, similarly to the network visualization and the overlay visualization. However, the area around each terms has a colour that indicates the density of items at that point. By default, colours range from blue to green to yellow. The larger the number of items in the neighbourhood of a point and the higher the weights of the neighbouring items, the closer the colour of the point is to yellow. On the contrary, the smaller the number of items in the neighbourhood of a point and the lower the weights of the neighbouring items, the closer the colour of the point is to blue.

As shown in the figure, the most relevant term that concentrates the most representative items density is "blockchain". Other important terms are: internet of things, security, network security, supply chains, privacy, digital storage.

5 Discussion and Conclusions

Using a transparent and objective procedure, the bibliometric analysis revealed the distribution structure of the literature on the key fields of BCT and industrial data protection and traceability. In particular, the following seven key topics have been identified as potential research directions useful for understanding the implications of BCT in the area of data protection and traceability: secure digital industry, secure data management, protection mechanisms, decentralised and

distributed architecture, security as a service, resilient security solutions, data manipulation techniques. These topics demonstrate an effective relationship of BCT for a secure management and traceability of industrial data. They suggest how the blockchain has become, over the years and the development of increasingly high-performance industrial applications, a key technology capable of enabling secure, traceable and tamper-proof transactions. This makes it possible not only to securely manage the enormous amount of data that characterize the IoT paradigm-based industrial environments (from the data collection phase to their transmission, storage and use), but also to deploy resilient security solutions that respond effectively to cyber threats, preserving the security of critical industrial assets while ensuring business continuity. These suggestions contribute in extending the corporate knowledge for the development of more sustainable business models.

The study, therefore, with the aim of guiding studies in the literature in the area of blockchain as a technology guaranteeing the security and traceability of industrial data, provides promising directions for future research. However, the study has some limitations that offer academics some suggestions for future investigations. In particular, the bibliometric analysis appears to be preliminary, relying on the Scopus database; in the future, further investigation could include the analysis of scientific articles from other sources such as Web of Science and PubMed. Furthermore, the interpretation of the resulting clusters could be distorted by the subjectivity and background of the researchers; therefore, in the future, content analysis could be implemented as a complementary method to improve the quality of the research and reveal other insights.

Acknowledgement

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Towards Sustainable Rural Development and Organisation

Mauro Romanelli

University of Naples Parthenope
Department of Business and Economics
Via G. Parisi, 13 80132 Napoli, Italy

Abstract

Sustainable rural development helps to improve the quality of rural environment communities, and relies on promoting multifunctional agriculture and driving rural business and entrepreneurship, structuring hybrid organisations that combine and reconcile market and social aspects as sources and visions leading to creating economic, social and public value within rural areas and communities. The aim of this study is to elucidate that driving sustainable rural development supports hybrid organisations that are driving value creation processes within rural areas and communities. Rural resources are emerging as a social and economic asset and value to be preserved for future generations. Rural resources shape the strategy and organisation of rural enterprises and communities. Rural development and multi-functionality in agriculture contribute to reconciling and combining business orientation, territorial identity, social value creation and benefits for communities, addressing strategic and organisational choices of rural entrepreneurs. Rural development policies contribute to driving and shaping the sustainability of European farm sector and rural areas, by retaining long-term strategic objectives with regards to the competitiveness of agriculture, ensuring sustainable management of natural resources and climate action and the balanced territorial development of rural areas. European institutions promote rural development in order to benefit rural enterprises and communities, exerting influence on the organisational and strategic choices of enterprises towards sustainability by following a hybrid pathway to value creation and organisation.

Keywords – Agriculture, EU framework, Hybrid organisations, Rural development, Sustainability

Paper type – Academic Research Paper

1 Introduction

Rural resources are becoming a fundamental support to start initiatives and sustain efforts to drive economic development and social growth in rural areas and communities, emerging as a value to orient cultural, strategic, market and organisational choices that rural enterprises and farms have to adopt in agriculture as an opportunity to revitalise rural territories and areas because rural areas contribute to sustainable and smart, productive and healthy growth (European Committee of the Regions, 2017). Investing for enhancing rural resources supports rural development as a paradigm that is leading to wealthy rural communities and driving value creation. Rural development is emerging as a new paradigm in which the agriculture is at the interface between actual and potential rural and no rural activities for constructing viable rural livelihoods (Ellis and Biggs, 2001). As a fundamental activity in rural areas and interface between community and the environment, the agriculture tends to be considered as a multifunctional activity when it has one or several functions in addition to its primary role. Promoting multifunctional agriculture supports sustainable rural development, leading to structuring hybrid rural organisations and businesses that combine and reconcile business and market aspects. Hybrid organisations tend to incorporate and reconcile competing elements drawn from different institutional logics (Pache and Santos, 2013) in order to secure endorsement from field-level actors managing heterogeneity of logics for ensuring the organisational functioning and reinforcing organisational actions (Besharov and Smith, 2014). Creating economic, social and public value in rural areas benefits businesses, people and communities in the rural landscape. Sustainable development in rural communities relies on enhancing rural resource as a kind of capital asset to be invested to benefit local communities by providing opportunities and facilities to improve the quality of rural environment (Garrod, Wornell and Youell, 2008).

The aim of this study is to elucidate that driving sustainable rural development helps to create hybrid organisations leading to value creation within rural areas and communities. The study relies on archival and qualitative data drawn by review of literature on the role of rural economies and entrepreneurship in order to sustain economic growth and development of rural communities. The European frameworks and guidelines governing the design of rural development and agriculture's policies are presented and analysed. The paper is structured as follows. After the introduction, the role of hybrid organisations is presented coherently with the rise of rural development that is encouraging a culture of

sustainability. In the third paragraph, the European Union framework concerning policies sustaining rural development in recent times is presented. In the fourth paragraph, some considerations on proceeding towards a sustainable rural development is elucidated. Finally, discussion and conclusions are outlined.

2 Hybrid organisations and rural development

As a fundamental activity in rural areas and interface between community and the environment, agriculture is considered as a multifunctional activity when it has one or several functions in addition to its primary role. Since the Cork declaration in 1996 that refers to multi-functionality in agriculture as activity shaping the landscape, providing environmental benefits for land management, natural resource conservation and biodiversity preservation (Garrod, Wornell and Youell, 2008), the farmers tend to hold a responsibility as the stewards of the natural resources in countryside, and contribute to socio-economic viability of rural areas, shaping the landscape and providing environmental benefits with regards to land conservation and sustainable management of renewable natural resources and preservation of biodiversity. Multi-functionality of agriculture refers to new farm-related activities and new markets as expression of new relations between agriculture, society, cities and countryside to drive for maintenance of rural landscapes and reinforcing rural economies as part of the social fabric of the countryside (Oecd, 2001). Multifunctional agriculture contributes to producing environmental effects in terms of landscape and open space amenities, enhancing of biodiversity, contrast to pollution, food security and safety, rural economic viability (Knickel, Renting and Douwe van der Ploeg, 2004).

Multi-functionality in agriculture emphasises economic, social and environmental functions assigned to agriculture as a provider of rural environmental goods, cultural heritage, environmental conservation in order to contribute to revitalising the viability of rural areas and providing environmental values conserving agro-ecological systems (Van Huylenbroeck, Vandermeulen, Mettepenningen and Verspecht, 2007). Promoting growth in rural areas relies on combining market and social aspects by doing business for creating economic, social and public value as a source for driving the growth of rural economies and leading to sustainable rural development. Rural resource is becoming increasingly subject to pressures arising from an ever wider range of economic, social, political and environmental influences. Developing innovative ways of doing business that align profit and social impact is leading to hybrids as organisations that bridge commercial and economic activities with addressing social problems by adopting

a social or environmental mission. Social business hybrids are facing the challenge of aligning the activities that generate profit (as value captured by the organisation for its owners) with the activities that generate impact as the value created by organisation for society in terms of environmental and social benefits. Hybrid organisations tend to innovate by reconciling competing expectations promoting the coherence between value capture and value creation (Santos, Pache and Birkholz, 2015). Hybrid organisations incorporate and reconcile competing elements drawn from different institutional logics (Pache and Santos, 2013) to secure endorsement from field-level actors managing heterogeneity of logics for ensuring the organisational functioning and reinforcing organisational actions (Besharov and Smith, 2014). Hybrid organising seems to be related to activities, structures, processes and meanings by which organisations tend to combine aspects of multiple organisational forms (Battilana and Lee, 2014). Rural developments concern with the reconfiguration of rural resources in terms of land, nature, eco-systems, animals, plants, town-countryside relations and networks to be reshaped and recombined. Rural development requires to create new products and services associated to new markets concerning cost reduction through new technological trajectories and the production of specific knowledge bases.

3 The European framework for promoting rural development

Promoting rural development was emerging as a relevant policy in the European Union. According to the first formal statement of rural policy European rural areas tend to be centers of renewable energy production and contribute to driving biodiversity preservation and protecting environmental resources (Commission of the European Communities, 1988). Following the Cork Declaration (1996) (Commission of the European Communities, 1996) preserving and improving the quality of rural environment should be integrated into all policies that relate to rural development sustaining the quality and amenity of rural landscapes by valorising natural resources, biodiversity and cultural identity coherently with a multi-disciplinary and multi-sector approach. Recently, planning the future of European rural development was emerging as a priority in the development of strategy enhancing both the quality and growth of rural economies. In the article 4 of the EU Regulation No 1305/2013 three **long-term overarching strategic objectives** for EU rural development policy in the 2014-2020 period were identified: fostering the competitiveness of agriculture; ensuring the sustainable management of natural resources, and climate action;

achieving a balanced territorial development of rural economies and communities including the creation and maintenance of employment. These objectives are translated into six European Union priorities for rural development: fostering knowledge transfer and innovation in agriculture, forestry and rural areas: by fostering innovation, cooperation and the development of the knowledge base in rural areas; by strengthening the links between agriculture, food production and forestry and research and innovation for improved environmental management; by fostering lifelong learning and vocational training in the agricultural and forestry sectors; enhancing the viability/competitiveness of all types of agriculture, and promoting innovative farm technologies and sustainable forest management: by improving the economic performance of all farms and facilitating farm restructuring and modernization increasing market participation and orientation as agricultural diversification; by facilitating the entry of skilled farmers and generational renewal; promoting food chain organisation, animal welfare and risk management in agriculture by improving competitiveness of primary producers by better integrating them into the agrifood chain by supporting farm risk prevention and management; restoring, preserving and enhancing ecosystems related to agriculture and forestry by enhancing biodiversity and improving water management, preventing soil erosion and improving soil management; promoting resource efficiency and supporting the shift toward a low-carbon and climate-resilient economy in the agriculture, food and forestry sectors; promoting social inclusion, poverty reduction and economic development in rural areas by facilitating diversification and creation of small enterprises and job creation, fostering local development in rural areas, enhancing the accessibility and use of information and communication technologies in rural areas. Member States will have to build their Rural Development Plans based upon at least four of the six common EU priorities.

According to the Cork 2.0 Declaration (2016) innovative, integrated and inclusive rural and agricultural policies in the European Union should follow some policy orientations: promoting rural prosperity in terms of innovative and inclusive solutions by fostering policies built on the identity and dynamism of rural areas, by promoting diversification and fostering entrepreneurship and employment for the wealth of rural communities and the resilience of farms; strengthening rural value chains by promoting policies reflecting emerging business opportunities for agriculture and forestry, and rural enterprises related to circular and green economies sustaining quality of products and healthy food; investing in rural viability and vitality by policies promoting rural quality of life

and meeting the aspiration of rural youth strengthening and aligning the development of rural and urban areas; preserving the rural environment by sustaining the land management as driver of the interface between citizens and the environment encouraging the delivery of environmental public goods like the preservation of natural and cultural heritage in terms of habitats of flora and fauna, landscape amenities depending on good functioning and social and economic development of farming and forestry systems; managing natural resources by developing innovative, science-based solutions allowing for producing more with less as to make available the use and employment of other resources for future generations; encouraging climate action by promoting the introduction and use of renewable energy and leading farmers and foresters to provide climate services implementing adaptive strategies; boosting knowledge and innovation focusing on social innovation, learning, education and vocational training, sustaining networking and cooperation, fostering access to sources of knowledge and technology for developing the needed skills, building closer relationships between knowledge providers, civil society and public authorities; enhancing rural governance relying on the effectiveness of regional and local governments and community-based groups; advancing policy delivery and simplification to build the trust of stakeholders; improving performance and accountability relying on credible monitoring and evaluation systems.

The Common agricultural policy (CAP) is about food, the environment and the countryside. The CAP is a partnership between society and agriculture that ensures a stable supply of food, safeguards farmers' income, protects the environment and keeps rural areas vibrant. The CAP 2023-27 focuses on a new way of working. It is a modernized policy, with a strong emphasis on results and performances. It focuses on ten specific objectives, linked to common EU goals for social, environmental, and economic sustainability in agriculture and rural areas. The CAP 2023-27 is built around ten key objectives, and focuses on social, environmental and economic goals: to increase competitiveness and contribute to food value; support initiatives and actions for managing climate change; to provide environmental care; to preserve landscapes and biodiversity; to support generational renewal; to drive vibrant rural areas; to protect food and health quality; to foster knowledge and innovation; to ensure a fair income for farmers. These objectives are the basis upon which EU countries designed their CAP Strategic Plans.

4 Towards sustainable rural development

Rural areas and resources provide an added value and potential for creativity and innovation, and contribute to driving sustainable growth (European Committee of the Regions, 2017). In the post-industrial stage of rurality, the preservation of the environment, security and quality of food are becoming the main priorities of policy agenda; there is an integration between economic activities, integration within territory between natural and social aspects, integration between local and global markets. The agriculture plays an autonomous and relevant role not merely accessory to manufacturing and services activities. Rurality becomes as a synonym of diversity as opposite to the homogeneity of urban societies and slack of bio-diversity, landscape, historical and heritage asset, tradition and values related to agriculture, and natural assets (Sotte, 2008). Sustaining rural development helps to maintain and revitalise rural economies and communities by creating and consolidating new linkages between agriculture and society, and providing a new set of responses to the income squeeze, opening up to new multifunctional enterprises and networks bridging rural and urban realities (Douwe van der Ploeg and Roep, 2003). Sustainability in agriculture concerns ecological, economic and social perspectives. In a sustainable agriculture there is qualitative and quantitative continuity in the use of resources that enables a dynamic character in the agriculture that is able to adapt to land use and changing needs of population, is based on the equilibrium between human activities, knowledge, technology and food production resources without causing degradation or pollution (Farshad and Zink, 1991). Promoting innovation systems helps to achieve sustainability in rural development and contributes to realigning agricultural and societal goals by fostering sustainable use of natural resources and competitiveness, creation of public goods and looking for new markets (Knickel, Brunori and Rand, 2009).

Sustainable development in the rural context relies on re-conceptualising rural resources as 'countryside capital' re-casting the rural resource as a kind of capital asset that can be invested in and from which a stream of benefits may be drawn. Investing in countryside capital may benefit the local community by providing opportunities, and facilities as to help to improve the quality of the rural environment and communities. Public institutions should promote, encourage, and support the sustainable development of rural entrepreneurship encouraging territories and communities to participate and benefit from entrepreneurial opportunities in rural areas (Garrod, Wornell and Youell, 2008). With regards to defining and implementing a transition strategy for promoting sustainable rural

development it is necessary to reduce the negative socio-environmental impacts of productive activities; broaden the participation of family farming in all kinds of markets; promote new forms of natural resource use; increase the overall productivity of the economy and well-being; revitalize and strengthen the endogenous local base of national economies, diversifying the productive profile of the country's territories. The final goal of all development strategies is related to both social and productive changes able to reduce external dependence in order to facilitate sustainability (CELAC, 2017).

5 Conclusions

Rural development and multi-functionality in agriculture should help to reconcile and combine business orientation, territorial identity, social value creation and benefits for communities in order to drive and address strategic and organisational choices of rural entrepreneurs. Rural development policies contribute to sustaining an approach to sustainability of EU farm sector and rural areas retaining long-term strategic objectives in terms of competitiveness of agriculture, ensuring sustainable management of natural resources and climate action and the balanced territorial development of rural areas. European rural development policies lead new entrepreneurial ventures to structuring as hybrid organisations managing multiple and different logics that combine commercial, profit and social dimensions by following different trajectories of development concerning alternative policy paradigms for agriculture, rural areas and countryside.

The key implications of this study are theoretical, managerial and concern policy choices. As organisations achieving sustainable development, rural enterprises and farms in agriculture tend to assume strategic choices and organisational shapes coherently with the aim to behave as hybrid organisations. As organisations following a pathway towards hybrid structure, rural enterprises tend to adopt fitting organisational arrangements and design paying attention to maintaining strategic coherence between business activities and social commitment in order to enhance the wealth of rural areas and provide benefits to rural communities. With regards to policy aspects, European institutions tend to promote and encourage rural development as a key strategy and source to benefit rural enterprises and communities exerting influence on the organisational and strategic choices of enterprises that are oriented to proceed towards sustainability by following a hybrid pathway. It is necessary that rural enterprises could assume and interiorize a culture of sustainability as a driver of

value creation in rural areas and environments and guiding norm of organisational choices and behaviours. European regulations and guidelines contribute to designing a cultural pathway leading to both strategic and organisational change by encouraging the adoption of business models that support the orientation to design of hybrid structures. Promoting sustainable rural development and encouraging a culture of sustainability in agriculture and rural areas should help to rediscover the potential of rural areas for economic and social growth as to drive rural communities to create sustainable value. Further research perspectives imply to investigate how farms in agriculture are developing an approach to sustainability by following a hybrid pathway to designing structure and select a business model for value creation in rural areas.

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Increasing Diversity in Aviation Industry

Federico de Andreis*

Università "Giustino Fortunato"
Via Raffaele Delcogliano, 12
82100 Benevento BN, Italy

Federico Maria Sottoriva

Università "Giustino Fortunato"
Via Raffaele Delcogliano, 12
82100 Benevento BN, Italy

* *Corresponding Author*

Abstract

Social and regulatory pressures and competitiveness are increasingly encouraging companies to invest in diversity to manage differences in the workplace. In service industries such as hospitality, tourism, and transport, the relationships and interface between customer and service are critical (Singal, 2014).
According to this approach in aviation companies, the subject of this is study, diversity management takes on even greater importance than in other industries (Steven et al., 2004).
The commercial aviation industry is a high-tech service industry, extremely competitive and sensitive to the customer-employee relationship, since it is obviously a service that is consumed at the same time it is delivered (Appelbaum, Fewster, 2004).
It appears known from the literature that diversity management plays a significant role in the organization's outcomes (Lorbiecki, Jack, 2000). This study seeks, in fact, to provide a brief review of the history of diversity management in organizations, aiming to identify how, from the business side, diversity management is perceived and considered and which strategies have been implemented, or are in the planning stages, that may prove useful.
In order to analyze the intangible aspects of airline and how attention to diversity can become an element of competitive advantage, a qualitative research methodology using a multiple case study was chosen in the paper, through an unstructured questionnaire interview. Specifically, direct interviews with three management figures in the aviation industry were chosen as the source of information collection.
This first explanatory research confirms that the best combination of differences and, thus, the management of human resources enable the enhancement of diversity in organizations, with performance level benefits.
Therefore, through the interview some strategies in aviation industry in order to sustain diversity management are highlighted.
The limitation concerns the number of pilot cases observed (three) Future lines of research will be focused on the study of other company to acquire more data on the topic.

Keywords - Diversity management, performance, aviation

1 Introduction

By definition, aviation exhibits a multicultural aspect of employment. Employees not only provide services to an international range of passengers, but also work, in many cases with multicultural colleagues. It therefore appears necessary for them to adapt to new cultures and societies with which they deal on a daily basis.

In the aviation industry, considering the diverse profile of the passengers being carried, companies have always tried and still try to design their products according to the different needs of their customers, in order to bridge the diversity gap that might emerge in the course of their experience, and become competitive in a highly challenging market (Lorenzoni, Lewis, 2004).

An airline with a well-trained and qualified management team can create a feeling of belonging within the staff community, which in turn is able to bond with colleagues and customers. All this allows any airline to differentiate itself among its competitors (Doumi et al., 2020).

Belonging, trust, and inclusion are then values to be promoted in transportation organizations as excellent characteristics not only of managerial management but also of customer service.

Transport services, in fact, by their nature represent something intangible albeit based on the use of tangible means of delivery. A comfortable seat, a good meal on board, a choice of many movies in the entertainment system are certainly elements that make the customer evaluate a trip positively, but how everything is offered, delivered and managed by the staff create an added value for passengers. The delivery of the transportation service, the customer satisfaction and quality therefore also depend on the actions of the staff which is an uncontrollable factor (Evans at al., 2003).

In addition, we should highlight that service providers are different from each other, and even the same provider may be different depending on the day, time or hour.

In this then, management has a kind of responsibility to provide service delivery standards that meet customer expectations, being able only to intervene in personnel management.

Taking into consideration the reality aforementioned, airlines are seeking to become more competitive in the marketplace; this is where the combination of staff well-being and service excellence comes in.

Within this framework, this paper focuses on the role of diversity in the airline industry and its role in supporting staff's sense of belonging and well-being, exploring how diversity can be a strategic management tool for maintaining a positive and supportive work environment (Duomi et al., 2020).

The aviation industry still suffers from a lack of diversity, especially in Europe.

Research on diversity in the airline industry is still in its early stages, and this is especially true for qualitative studies.

Therefore, this article addresses the issue of diversity perceptions and diversity management within aviation companies in Italy, following the methodological principles of qualitative social research.

The objective of the paper is therefore to understand the perception of diversity in civil aviation in Italy. In fact, considering the benefit of diversity management in an industry where a potential shortage of personnel often looms, it is in the interest of operators to have access to a pool of employees, well included in the organizations, as diverse as possible, which allows them to satisfy the interest of customers.

The analysis then focuses on how diversity management is known and applied in the industry being researched and what are some elements of diversity that can be worked on.

In summary, the objective of the research is thus to answer the following questions:

> *RQ1.What threads of diversity management can be related to aviation?*
> *RQ2. How can diversity management be applied, in response to the most obvious elements of diversity?*

To answer the first question, a review of the literature, which is still not very structured in the aviation sector, was conducted, and to answer the second research question, interviews were conducted with three Italian airline management figures. From such qualitative research, suggestions are then drawn on possible strategies to be applied.

The research contributes to extending the literature on diversity management as it relates to transport organizations and the final implications are vast and pervasive.

The paper is structured as follows: section 2 addresses the literature review and performs an analysis on the diversity issue in civil aviation. section 3 presents the

research methodology, section 4 describes and discusses the case studies and identify the discussions; finally, section 5 identify conclusions, limitations and possible lines of future research.

2 Literature review

When developing research on diversity, we cannot disregard an evolution of the literature, which shows how the characteristics of the articles have changed, i.e., their provenance, the methodology used and the departments involved (Paoloni, Demartini, 2016).

Many researchers have tackled the topic of human resource management and the majority of them believe that it is one of the key elements in making companies competitive; people make a difference in terms of competitiveness and business results when their development and enhancement is nurtured (Garbellano, Tesio, 2010).

Therefore, the issue of human resources plays a central and predominant role in any industry; special attention must be paid to how to manage them optimally, not only professionally but also personally.

Managing the skilled workforce better by integrating backgrounds, cultures and skills into heterogeneous, higher-performing organizations enables companies to achieve competitive advantages and results, particularly in companies, such as those in air transportation, where there is a strong relationship between human resources and customers (de Andreis et al., 2022).

From a managerial point of view, therefore, it appears necessary to thoroughly understand the role of the customer, both as a user of a good or service and as a vehicle of information regarding his or her experience with the organization. The analysis of customer demand and satisfaction appears complex, since these are driven by subjective, psychological and/or social factors (Tsiotsou, Ratten, 2010).

The ability of companies to meet these needs defines the level of customer satisfaction, which in turn will determine the retention rate and contribute to the development of spontaneous advertising processes by customers.

Therefore, among the most important challenges for the aviation industry is the development of staff competence and professionalism and their ability to make the customer experience exciting and memorable (Bharwani, Jauhari, 2010).

Human resource management is defined as an integrated system of complex and interconnected activities and tasks aimed at ensuring the development of human potential (planning, attraction and recruitment, selection, disposition); the retention of human resources (health and safety, organizational culture, employee

loyalty, employee services) the ability to motivate and reward people (monitoring and evaluating work efficiency, motivation, rewards, benefits) and, finally, investment in training and professional development (education and training, human resource development, career advancement, management) (Bahtijarević-Šiber, 2014).

Thus, the purpose of human resource management, in highly competitive industries such as air transport, is to ensure a competent and quality workforce through the creation of a stimulating work environment; in fact, employee satisfaction will be the key element for the success of the organization, increasing its competitiveness (Belias et al., 2017; Barney, 2001).

In industries such as transportation and tourism, human capital and its strategic management are the key elements in improving an organization's resources and thus represent a source of sustainable competitive advantage (Pasban, Nojedeh, 2016). In fact, human resources are responsible for the quality of the consumer experience, and their knowledge and skills become crucial for customer satisfaction and loyalty, as well as for the perception of the service itself and, consequently, for the image of the companies (Bozzato et al., 2021), since it is, precisely in aviation, that the contact between human resources and customers, i.e., the time during which the customer is physically present in the system compared to the total production time, plays a determined role in creating a competitive advantage.

It is necessary to promote the process of "humanization of resources" through which management considers the "person" before the "professional," using policies enhancing employees' satisfaction and creating a motivational climate in the work environment. It follows that human resources, as a fundamental part of the organizational environment, can act as a competitive advantage if used to the extent that best suits the company (de Andreis, et al., 2022).

Having defined the importance of human resources in aviation and the proper ways to manage them, it is necessary to highlight that not all people are the same and, therefore, each person requires a different approach. A culture has developed over the years, leading to identify people's roles and skills based on certain personal characteristics, such as age, gender, nationality, etc. People all have personal characteristics that distinguish them, but these must be separated from professional skills. In fact, only the latter make people suitable or unsuitable for certain roles.

Sociocultural and economic transformations, liberalization of the economy, the process of globalization, and changes in customer needs have substantially

increased the diversity of the workforce, forcing organizations to make their workforce more varied, innovative, and competitive (Cook, Glass, 2009). An innovative workforce can be ensured by hiring talented individuals from diverse backgrounds to deliver better products and services to customers and companies (Salau et al., 2018).

Thus, human resource enhancement involves understanding and properly managing diversity, which is a positive distinguishing feature and can be an important managerial tool to gain competitive advantage.

Diversity has been defined in various ways, but it is commonly believed to exist at two levels: surface-level diversity and deep-level diversity.

Surface-level diversity has primary dimensions such as gender, race, age, and sexual orientation and secondary dimensions such as education, marital status, work experience, and functional background (Mok, 2002; Van Knippenberg, Dijksterhuis, 2000); deep-level diversity generally refers to cognitive diversity, a variable that is not immediately apparent and, therefore, is difficult to measure (McMahon, 2011).

Primary dimensions play a predominant role in diversity and performance management because they remain largely constant over time and determine how an organization relates to diversity in terms of employment, promotion, employment benefits, and company-wide delivery practices. Each individual possesses unique knowledge that organizations must recognize for their holistic development; therefore, diversity management plays a huge role in knowledge sharing and overall organizational development (Yadav, Lenka, 2020).

Several studies have also discussed the relationship between diversity and organizational performance. To understand and manage the dynamics of workforce diversity, researchers have explored the outcomes of diversity at the individual (Flynn et al., 2001; Ancona, Caldwell D F, 1999), group (Schippers et al., 2003; Leslie, 2017) and organizational (Richard, Johnson, 2001; Armstrong et al., 2010) levels.

Specifically, companies benefit from diversity in several ways (Singal, 2014, Hansen, 2003). Firstly, diversity broadens the pool of potential candidates and suppliers, leading to a larger resource base, higher quality, and lower costs (Niederle et al., 2013). Secondly, diversity in the workplace often increases individual performance and emphasizes individual-company identification, increasing productivity and job satisfaction and reducing voluntary turnover and recruitment and training costs (McKay et al., 2009). In addition, it is important to

note that higher job satisfaction improves the quality of employee-customer interaction (Koys, 2001).

Among the benefits, it should also be pointed out that a diverse workforce also provides access to new networks and expands sources of information (Williams, O'Reilly, 1998). Thus, a diverse workforce brings diversity of thought that promotes a creative and innovative environment (Bantel, Jackson, 1989), and finally, a better cultural congruence between service staff and customers that improves consumer experience and satisfaction.

In order to implement a "building a diverse environment" program that works, it is necessary to provide specific diversity training to managers and traditional employees, in order to make everyone aware of the opportunities presented by this paradigm shift.

The literature is thus divided between those who highlight the positive influence of diversity management on organizational performance and those who emphasize its negative aspects (Yadav, Lenka, 2020). Analyzing what has been described above, it can be said that numerous studies have been conducted on the subject; many of them show that diversity is an important characteristic for organizations and that the discriminating factor between a positive or negative impact on business performance is precisely the organization's ability to manage people.

It now appears necessary to explore further the concept of diversity and the different declinations in which it exists, as it is a broad and complex topic (Grin, 2003).

Diversity can be analyzed with an objective or subjective criterion. The objective one makes the concept of diversity coincide with that of minority, recognizing a subject as different if he or she belongs to a minority group compared to the majority of society (Moscovici, Faucheux 1972), while the subjective one sees diversity arising not from an objective reality of things but from the ways in which observers view it (Gergen, 1994).

According to this approach, diversity is therefore not objectifiable since there is no value system, a benchmark, a "normality", as opposed to which one can to define someone or something as "different."

Each individual, in fact, has a different perception of things and a different conception of the world.

Highlighting the presence of diversity, however, regardless of context, means for individuals, and consequently for organizations, to implicitly recognizing that there are no standards of any kind, and consequently acknowledging that every

relationship, situation, and condition must be treated and handled in a way that is precisely "different" from another.

Especially in the case of human relationships, even within organizational contexts, there is not a universal approach, since human beings in their attitudes and behavior are the symbol of diversity.

As previously described, diversity can refer to gender, race, social status, ideology, religious orientation and numerous other variables. Some diversity is part of the innate heritage of the individual and cannot be changed, while others refer to elements acquired over time (Loden, 1995). Identifying the various diversities in a Gardenswartz and Rowe (2003) identified the various diversities in a business context were, theorizing a decidedly comprehensive model that describes four levels of diversity. This model explains not only the division into levels but the complexity of the interconnection between them in describing the reality of companies in diversity management.

The central level of the model is represented by *personality* or *inner level* and considers the set of values and beliefs driving individual behaviors, characterized by both genetic and sociocultural basis; consequently, in the organizations, these aspects influence the member's choices, actions and overall performance. The second level is the *internal dimension* or *core dimension* which groups specificities such as gender, nationality, sexual and religious orientation, age, mental and physical abilities and derive from hereditary or group-specific conditions, that are independent of the individual's will and therefore cannot be the cause of different treatment between individuals, hence the subject of anti-discrimination regulations. We can then identify the third level with the *external dimension,* to which characteristics, such as income, geographic location, personal and recreational habits, family status, belong; these are determined mainly by family and personal conditions, which can be modified over time in a partial way by the individual's actions. In this case, protective actions aim at the pursuit of equal treatment among individuals, such as supporting people born in disadvantaged areas or in degraded families. Finally, the last is that of the *organizational dimension*, which identifies aspects independently defined by the organization (roles, responsibilities and relationships within the company) and implicitly generate differentiations since belonging to a company function or performing a task can lead to certain discriminations, as, for example, in the case access to training, part-time, career progression or smart-working (Gardenswartz, Rowe, 2003). The existence of various diversities is justified by the degree of pervasiveness of the differences: in the innermost levels in fact, we can find the

diversities closely related to the person and those characteristics that are immutable; in the outermost levels are those characters that are more influenced by the external environment and consequently more mutable than the previous ones.

It is important to emphasize that the model highlights how the condition of each individual is the result of multiple aspects that the model itself identifies and that the company must take into account their evolution, which changes individual needs, expectations and goals by placing the psychological contract between company and worker in continuous evolution.

Diversity in group membership can have both advantages and disadvantages for group and organizational performance (Knouse, Dansby, 1999). Thus, the challenge for organizations is therefore to be able to identify, manage, and enhance those differences that make each individual unique, creating systems that can eliminate the discrimination inherent in organizational and relational management processes.

To this end, the creation of a primarily cultural system capable of governing this challenge represents a distinctive and competitive element in a context in which both the exogenous perspective (external environment) and the endogenous perspective (corporate strategies) represent important levers for the implementation of diversity management actions.

In the business context, the issue to be resolved concerns the management of those diversities that by nature are not are modifiable, making it necessary to identify the best ways of managing them for the benefit of the employees and of the entire organization (Kochan et al., 2003).

The presence of different identity groups in a work context has as its consequence the emergence of discrimination, a condition that does not benefit the company and that can be handled through human resource management models.

Having described the importance and necessity of diversity management, we must then consider how companies can apply it.

The company that decides to enforce diversity management must initially start with a detailed and accurate internal analysis of personnel.

Each organization has its own structure and composition and this implies that each organization is facing with different situations and issues. The company carries on a culture and values, the so-called "organizational culture," which inevitably affects the company's performance and the personality of the members (Parrotta et al, 2012).

Often and often adopting diversity management involves having to make a radical change within the organizational structure in the strict sense, which leads to having to face certain risks in exchange for obtaining various benefits.

Applying diversity management can be decidedly easy in newly founded and established, as it seeks to prevent a concrete issue that might arise in the future; unlike this application is more complex, slow and tortuous in the case of historic companies, or otherwise of less recent foundation, since it is more likely that an organizational culture has become more firmly rooted in them.

Another characteristic that must be taken into account when making the decision to implement diversity management is to understand what type of management is needed. In fact, it should be specified that here, too, there is not a unique type of diversity management, but rather there are different kinds based on to the diversity found in the company. For example, a long-lived company that has been in business for many years and has employed workers for several generations may have to deal with the problem of seniority, as a result of a high presence of particularly adult and older employees. In contrast a newly founded company might see many young people employed internally, not encountering a seniority management problem as much as, for example, a difficulty in managing the multi-ethnicity of the workforce.

That being said, we can move to analyze diversity management in aviation, where companies are both historical and relatively new, and try to understand what the main diversity management issues are and what strategies might be put in place.

In service industries such as hospitality, tourism and aviation, the relationships and interface between customer and service are critical, considering that the influence of organizational culture is strategic in the way services are delivered and consequently for company satisfaction and corporate image. According to this approach in aviation companies, the subject of this is study, diversity management takes on even greater importance than in other industries, playing a significant role in the organization's outcomes.

The commercial aviation industry is a high-tech service industry, extremely competitive and sensitive to the customer-employee relationship, since it is obviously a service that is consumed at the same time it is delivered.

3 Methodology

To understand, therefore, the main levers on which diversity management is operating in aviation in Italy, we used a qualitative research methodology, through a multiple case (Yin, 2014).

Specifically, we interviewed, between February and March 2023, three management figures in the aviation industry in Italy, between as the source of information collection, using open-ended questionnaire, administered in a flexible form and integrated according to the specific characteristics of the individual interviewees.

4 Case studies: analysis and discussion

The case studies observed involved three Italian air transport companies with different company histories, one young, one historical and one resulting from several company mergers.

Briefly respondents, narrating the personnel management difficulties they face, highlight how the main points of disagreement concern the management of gender differences, age differences, cultural differences, while and they have not encountered issues regarding disability, having dedicated inclusive policies to it according to legal standards.

Getting more specific about the pilot cases. the first interview is about an airline that operates scheduled and charter flights founded last year (Airline A), the second has inherited the network, staff and aircraft from a historical airline (Airline B) and the third one third, recently out of operation, stemmed from a historic company operating on the national network that had merged first with a charter company and later with a large international airline (Airline C).

Before tracing what actions on management's part were put in place to reduce, it is necessary to understand how diversity affected the three realities differently, describing what emerges in the interviews and contextualizing he diversity issues previously outlined.

In the three cases, as well as in other airline companies in Europe and around the world (de Andreis, 2023), the issue of gender difference presented itself extensively.

In the investigated realities, there is a historical trend that female employment is significantly lower than male employment, especially when it comes to top management roles. The second issue detected concerns the ageing, relating to diversity from the point of view of seniority in the mosaic of personnel; there are

in fact newly hired workers who are young or older, and workers who are less recent hires who are also young or older. The third important aspect is the cultural aspect, arising from current trends that have seen society in all Western countries becoming increasingly multiethnic, encompassing cultures from all parts of the world.

According to the survey, all three companies state they have engaged in diversity management, although there is no a diversity management figure and all policies are implemented by general human resource management. The first problem concerning gender diversity is indicated as the greatest by the three realities; in company A age difference, indicated as the second problem in airline B and as the third in airline C, and cultural differences are scarcely present, while culture difference seems to affect only company C.

It follows that the diversity issues are a strongly influenced by the culture and the history of the organizations.

For the respondent the first actions to reduce diversity belong to the recruitment stage, when removing hiring biases appears necessary, since often people unintentionally select those who they feel similar to.

A second possible measure highlighted in the interviews is the raising awareness of the need to increase diversity, since making the topic a regular conversation helps foster a culture of inclusion.

A further action relates to leadership, responsible for skills in staff creation and management, which should pave the way for greater inclusion, both by supporting openness and tolerance and by ensuring diversity in the company's most important workplaces. in addition, programs also can help members with different backgrounds and levels get to know each other, have different perspectives, bridge the gap, and encourage inclusion.

The three interviewees were then asked to better explain how the highlighted diversity factors were impacting business reality and what actions they had and were implementing.

About ageing Airline B confirms that among recently hired employees there can be a problem of a lack of professionalism; on the contrary among older employees professionalism is present but the problem concerns its fading as time goes by or is due to the difficulty of accepting organizational changes or novelty.

Seniority then, in some cases, emerges as an organizational problem, especially because it is used, principally in the past, as an operational management criterion in assigning shifts, vacations, qualification changes etc.

Associated with different age, different skills and competencies are developed; older people lose some skills in a process called de-professionalization but in return acquire more capabilities: they will be less suited to jobs that involve more fatigue but more appropriate for organizational jobs, since over time they develop a strong sense of respect for colleagues, a greater sense of responsibility and a marked tendency to respect hierarchy. On the other hand, younger workers have greater creativity, propensity for innovation and novelty, and familiarity with computer systems.

It is therefore up to management, to capture all the skills that distinguish workers and decide, in relation to their age, how to relate to them, finding them the best place in the business context to derive the maximum benefit.

The concrete intervention suggested toward aging therefore focuses on the proper management of aged and older workers as opposed to younger workers. In fact, for younger workers, job specialization courses can be introduced for the tasks they perform to increase the degree of professionalism. On the opposite side, efforts are made to manage those who are older, creating a more inclusive and suitable work environment for them.

Regarding seniority, Airline B suggests a more meritocratic approach, derived from internal assessments and productivity indexes.

The management of former Airline C, which saw two already very different companies merge with a third non-Italian company, becoming a complex, multiethnic entity with very different cultures. Here, too, managing diversity from a managerial and organizational perspective took time and required training and awareness-raising among staff.

The goal of the actions has been to enable staff to be in a smooth working environment that allows them to bring out their potential, undoubtedly guaranteeing the company greater efficiency on the part of human capital. The organization says that it has taken diversity into account by encouraging activities that facilitate inclusion, believing that employees, free to themselves in every point of view, will have a different conception of their jobs the environment in which they operate, will face their duties with a different psychological condition, being more efficient and more productive.

Finally, the three airlines responded regarding gender diversity, mainly agreeing that the female component is, as in general in the industry (de Andreis, 2023), strongly underrepresented; in line with the global data showing that less than 5% of CEOs, less than 10 percent of pilots and fewer than 13% of top executives are women in the global airline industry. Additionally, they state that

the areas with the largest gaps include technical operations and leadership positions (Lutte, Morrison, 2022).

After analyzed the main aspects of diversity, respondents, through guided questions, were asked to give their opinion on diversity and business performance.

To structure these questions that would help in the understandings of the aforementioned pair, some hypotheses of a research conducted among employees (around 400) of European airlines were used (Duomi et al., 2020). Questions were then prepared on these hypotheses to measure the validity from a managerial point of view.

The first hypothesis, about the relationship between employment status and the ability to manage different customers, with benefit in the perception of service offered, that exposed a link between occupational status (full/partial time, causal, contract) and handling diverse customers, was rejected. The three managers interviewed also confirm that employment status does not affect performance, indeed in cases This result confirms that employees with different professional backgrounds and experiences may have a variety of attitudes in their work environment (Indoria et al., 2017) regardless of the form of contracting.

The second hypothesis, about a link between tenure/experience in a company and handling diverse customers, was not supported. Again, managers interviewed confirmed that it is not the experience in the role but the problem solving skills that fronts alternative solutions to a competitive business environment (Cletus et al.).

The third hypothesis used concerns the existence of a relationship between the personal experiences in the airline and the daily interaction with other colleagues and customers. This hypothesis was confirmed, deriving mainly from the rights and responsibilities of both parties. Managers interviewed also confirm that when diversity appears to be respected it has the potential to unite and promote collective strengths, improving performance and productivity.

It thus appears from such reflections that contractual status does not affect relationships with other colleagues and clients, as does tenure and experience in the role. On the opposite, in the daily experience, when diversity appears to be observed, shared and respected appears to be an asset to the organization.

Finishing the interviews, opinion was asked about diversity management and possible areas of intervention. The respondents showed that all three companies are aware that being able to better interpret the diversity and distinctiveness of

their people has a real advantage in the professional scenario of the present and of the immediate future.

In addition, the same assert that dealing with diversity stems from external factors, namely those that relate to the context in which the company is embedded, such as demographic changes, socio-political or legal drivers global economic trends, technological innovations, pressure from external stakeholders etc., and from internal factors, that are part of the organization, i.e. the heterogeneity of the staff, organizational culture and values, strategy and mission, , and economic and image benefits etc. (Ibrahim, Harrison, 2022).

Finally, the three managers interviewed were asked what strategies might prove useful in implementing diversity.

The trees agreed on acting at the grassroots, that is, as mentioned, by selecting resources from diverse backgrounds, considering this action as a functional element of organizational change.

Further step is to formulate a company vision and mission that also considers the issue of diversity. This step should involve management and key stakeholders, focusing on the strengths and weaknesses, threats and opportunities that the contingent scenario presents to the company.

It would then be necessary to work, after observing and analyzing the organization's internal environment, on strategy, sharing and highlighting the way in which the principles of diversity management are to be applied.

Respondents were then further asked to reflect on *diversity audits*, a process of reading diversity in the company. Although never applied, all three respondents, would find it useful to observe management and members' attitudes on diversity, to analyze organizational culture more pointedly, identifying areas for intervention.

5 Conclusions and limitations

Inclusion and enhancement of diversity are good ethical business practices, even the aviation industry, as seen, can benefit from increasing diversity.

Opportunities for growth abound in the areas of diversity, equity and inclusion. A diverse group of managers and employees can offer the company different perspectives on various areas and create a more inclusive culture and diversity and inclusiveness could also increase customer relations.

As seen, there is still a limited specific literature on civil aviation and diversity management, but, in concrete terms, diversity management policies can manifest themselves in a variety of ways. Of course, we should not assume that there is a

one-size-fits-all strategy: diversity management must be strongly contextualized according to the context of the organization, both from an external and internal factors perspective.

Diversity management activities must therefore integrate diversity ideas and practices into the managerial and learning processes within a company and its work environment.

The use of case studies then showed which diversity factors are most evident in civil aviation in Italy.

While the research shows some limitations, and as future areas of research it would be interesting to broaden the focus to other international realities, it is interesting to note that principally elements of diversity relate to gender, age and cultural differences.

Although the figure of the diversity manager does not exist yet in the reality investigated. At the human resource management level, these professional figures know the importance of this aspect of management, understanding its areas of intervention and possible benefits.

In fact, the people interviewed are aware of how inclusion passes through enabling group members to be and do together, working on concrete answers to real problems, inventing and discovering solutions that become object and experience of learning.

Interventions on diversity develop through organizational culture. Itis precisely in the processes of group composition, enhancement of singularities and connection, that the company can act those criteria of inclusion (or exclusion) that substantiate its culture and constitute fundamental opportunities to act in daily practice the processes of breaking down physical, architectural, social and cultural barriers (Christian et al., 2006; James, 2004)

Above all, organizational change, like any change, needs for its success a plan of action, a medium- to long-term vision, a design that allows, day by day, to guide and indicate the actions capable of sustaining and strengthening it (Esty et al., 2000; Kollen, 2019).

If, therefore, we want to effectively change the organizational sphere and with it the cultural progress of which diversity management is both the origin and the result, it is essential that this process involves all company personnel and be pervasive in organizational practices and values, be based on practices and processes that support it, and be carried out through concrete, visible and collectively participated actions (Lorbiecki, Jack, 2000).

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Female Leadership Engagement in the Italian Audio-Visual Companies: The Role of Soft Power

Mihaela Gavrila

Department of Communication and Social Research
Sapienza University of Rome
Via Salaria 113, 00198 Rome (RM) Italy

Giuseppe Modaffari*

Department of Law and Economics of Productive Activities
Sapienza University of Rome
Via del Castro Laurenziano 9, 00161 Rome (RM) Italy

Camilla Rumi

Department of Communication and Social Research
Sapienza University of Rome
Via Salaria 113, 00198 Rome (RM) Italy

* *Corresponding author*

Abstract

Defining the pillars of sustainable development, the 2030 Agenda recalls inequality and valuing diversity as an asset. Diversity management can be defined as a managerial approach pursuing an active and conscious development of a forward-looking, value-oriented strategic and communicative managerial process of accepting differences and using some differences and similarities as a potential of the organization, a process that creates added value to the enterprise. However, a lack of literature emerges regarding the studies on "behind the line" themes, which represent the key factors for the companies operating into the audiovisual industry. Especially, one of these regards soft power meaning the use and persuasion to change minds and influence behavior. In this stream fits in the present research aiming to analyse how women's leadership can support audiovisual companies in reaching sustainable development.

Qualitative face to face surveys methodology supports the paper, analysing 16 in-depth interviews. The interviews were conducted mainly with key figures of several audiovisual companies such as TV producers, production managers, directors of public and private TV networks, and heads of audiovisive archives.

The positive role of female leadership in the audiovisual industry is confirmed. From executive appointments to new recognition paradigms, inclusion is on the 2022 agenda of the audiovisual world. A growing presence of roles and productions of female filmmakers is confirmed, although the gap between men and women is still very wide. Several insights

emerge from the study of soft power topics, linking them directly to themes like training, innovation, responsibility, and change that emerge from the interviews.
The present study has several theoretical and practical implications. From theoretical perspective, it enriches the literature on gender study fields. Also, several aspects of the company's sustainable development and diversity management have been treated. From practical perspective, the present research points out the main features in terms of soft skills that female leadership must fulfil in order to achieve sustainable development for the company.
The main limitation of the research could be recognised to the number of interviews conducted. The future lines of research aim to expand the survey, also considering international entities. This perspective will help the authors in identifying the main characteristics of women managers that could allow the audiovisual companies in reaching the best outcome format for the market. Moreover, extending the analysis could promote the generalisation of the main findings of the research.

Keywords – women, leadership, diversity management in audio-visual companies, soft power, sustainability

Paper type – Academic Research Paper

1 Introduction

Women-led powers in audiovisual companies are increasingly making their mark in the industry. Recent data (Brand Finance, 2021) confirms that companies aiming to better manage their international brands must strategically bid on young people and women leaders.

Women leaders bring a unique perspective to the table, which can lead to more diverse and inclusive storytelling and content creation. They can also challenge traditional gender roles and stereotypes in the industry, paving the way for more opportunities for women and other underrepresented groups (Liddy and O'Brien, 2021). Additionally, women leaders can bring a fresh approach to business strategies and decision-making, which can improve the overall performance and success of audiovisual companies (Andersen and Jensen, 2014; Blass et al., 2022). Some examples of successful women-led audiovisual companies include Reese Witherspoon's Hello Sunshine, Ava DuVernay's ARRAY, and Shonda Rhimes' Shondaland. As the industry continues to evolve, women-led powers in audiovisual companies will undoubtedly play a significant role in shaping its future. The topics discussed, fall into the diversity management stream, which could be summarized as an active and conscious development of a forward-looking, value-oriented strategic and communicative managerial process of accepting differences and using some differences and similarities as a potential

of the organisation, a process that creates added value to the enterprise (Keil et al., 2007; Marr and Schiuma, 2001; Davenport and Prusak, 1998; Barney, 1991). Reaching active and conscious development accepting differences, hence, assumes to pursue development inspired by the principles of sustainability, not surprisingly, diversity management issues are among the topics of goal 5 of the sustainable development goals (SDGs) issued by the United-Nations (Paoloni et al., 2023a; Dello Strologo et al., 2022).

Diversity management and sustainability are two interconnected concepts that are essential for organizations to thrive in the long run (Paoloni et al. 2023b). Diversity management involves creating an inclusive workplace culture that values and respects individuals from diverse backgrounds, including different races, genders, ethnicities, religions, sexual orientations, and abilities. On the other hand, sustainability focuses on balancing economic, social, and environmental factors to meet the needs of the present without compromising the ability of future generations to meet their own needs (Elkington, 1998; Alhaaddi, 2015; Dal Mas and Paoloni, 2020). By embracing diversity and inclusion, organizations can tap into a wider pool of talent, ideas, and perspectives, which can lead to better decision-making, innovation, and creativity.

From what is written, sustainability is becoming an increasingly important consideration for audiovisual companies. As the world becomes more aware of the environmental impact of human activities, there is a growing expectation for businesses to operate in a sustainable manner. Audiovisual companies can contribute to sustainability in several ways. For instance, it can incorporate sustainability into their content by promoting environmentally responsible behaviors and raising awareness about sustainability issues (Lupu et al., 2023).

They can use energy-efficient equipment and lighting, minimize waste and recycle materials, and reduce carbon emissions from transportation and production processes. Also, by embracing sustainability, audiovisual companies can not only reduce their environmental footprint but also enhance their reputation, attract environmentally conscious customers, and create a positive impact on society. Therefore, for this kind of companies become crucial to prioritize sustainability in their operations and content creation to contribute to a sustainable future. By adopting sustainable practices, organizations can reduce their environmental footprint, improve their reputation, and contribute to the well-being of their stakeholders and society as a whole.

Hence, diversity management and sustainability are not only the right things to do, but they can also be a source of competitive advantage and long-term

success for organizations. In this direction, according to Global Soft Power Index, which highlights how the companies aiming to manage their international brands better, audiovisual companies must strategically invest in young people and women leaders, crucial during pandemic periods (Rumi, 2020). Although the gender gap is still very wide in the entire creative and cultural sector, something is changing throughout the Italian audiovisual world.

Fostering this recognition, as in the whole European context, are organizations and associations committed to enhancing the female presence in all-around entertainment, such as the Italian division of WIFTM (Women in Film, Television and Media).

However, a lack of literature emerges regarding the studies on "behind the line" themes, which represent the key factors for this industry. Specifically, one of these regards soft power, i.e., the use and persuasion to change minds and influence behaviour. Its main sources include culture, political values, and positive global engagement.

In this stream fits in the present work aiming to define the possible identikit of women managers in the audiovisual industries and the contribution they make to improving the positioning of Italian audiovisual production in national and international markets. Particularly, the present study investigates on *how women's leadership can support audio-visual companies in reaching sustainable development (RQ1)*?

To reach the declared goal, a qualitative methodology using a face-to-face survey analysis based on 16 in-depth interviews supports the paper. The interviews were conducted mainly with companies' key figures/role, such as TV producers, production managers, directors of public and private TV networks, heads of audiovisual archives.

The analysis reveals the importance of supporting talented women emerging around the world, also confirming the persistence of an education gap between men and women. It is extremely important to provide support with the training and job opportunities needed to give audiovisual women a voice. This needs for support come from a shortage of soft skills, capable of creating more inclusive opportunities for all in a strategic sector, and of powerfully influencing imaginations.

The originality of this study can be observed from a theoretical and a practical perspective. From the theoretical perspective, the present research contributes into gender studies literature, deeping to the topic of diversity management and sustainability. From the practical perspective, the originality of the paper can be

can be linked to the usefulness that the contribution provides in describing the needs of a specific sector such as audiovisual, highlighting the ongoing presence of gender gaps.

The main limitation of the study could be recognised to the number of observations. In fact, in the future, authors will be implementing the research with new interviews in order to try to be able to generalize the results obtained. In addition, future works will be directed toward expanding the survey to international audiovisual content as well.

This work is organized as follows. Section 2 proposes an insight into the main literature strands; section 3 describes the methodology, while section 4 presents the results from the interviews. Section 5 provides concluding remarks and summarizes the main implications of the work. The final section (6) details the research limitations and future direction.

2 Literature review - From gender gap to diversity management: inclusion as a new audio-visual paradigm

The present section investigates the progressive affirmation of inclusion as a new paradigm in the audiovisual sector, starting with prestigious studies highlighting the increasingly close relationship between women and Soft Power (Brand Finance, 2021). In international relations since the 1980s, the term "soft power" describes the ability of a political power to influence through intangible resources such as culture, values, and politics. However, over time the concept has progressively taken on a strategic dimension to describe and understand a country's ability to exert influence and improve its international image. An image that no longer depends as much or only on the exercise of Hard Power and the consequent costly search for new protection systems, linked to a coercive capacity resulting from a nation's military and economic strength, but on the exercise of a new power, "the other side of power" (Nye, 2004, 2009).

Indeed, these studies indicate that governments intent on improving their international brand management and influence in terms of soft power must strategically focus on young people (especially millennials), considered the most receptive target to nation-branding. However, the focus should also be on female leadership, capable of generating governance practices oriented by a shared public agenda capable of ensuring resilient transformation.

The female leadership, supported with conviction by the UN 2030 Agenda, which already identified gender equality and women's self-determination as an unavoidable stage in the realisation of a new development model (Paoloni et al.,

2023a; Dello Strologo et al., 2022) aimed at integrating the social, cultural, political, economic, and environmental dimensions, is confirmed by the analysis of the political framework called upon to manage the emergency dictated by Covid-19. Adopting a gender-sensitive perspective, even in interpreting the dynamics that most characterised the pandemic period (Rumi, 2020), is a courageous but decisive choice to examine and fully understand the social transformations underway (Zemon Davis, 1976; Touraine, 2006).

It is no coincidence that the states that responded most efficiently to the pandemic had female heads of state (Wittenberg-Cox, 2020), showing an alternative way of exercising power and giving rise to examples of true female leadership in the management of an unprecedented crisis. Women leaders who distinguished themselves in managing the pandemic with humanity and the ability to generate a transversal consensus among the population were "*more respectful of limits, more attentive to rights, more cooperative, capable of reassuring, less aggressive, less prone to boasting, reluctant to go the extra mile, but capable of throwing their heart over the obstacle*" (Soave, 2020).

While it is well known that women leaders have managed the pandemic far more effectively and consistently than their male counterparts, it is not as well known that female leadership has performed better in all the metrics examined to draw up the Global Soft Power Index, and in particular in those that best enable the maintenance of long-term achievements (such as governance or international relations). These are key prerequisites for a nation to thrive in an uncertain and volatile environment, called upon to capitalise on the knowledge gained, especially in terms of soft power, for the design and implementation of effective recovery strategies.

Despite several studies[1] that have long shown that more women at the top of companies equals greater profitability and better management, "diversity" still struggles, regardless of sector, to become a strategic element in running companies. Moreover, this awareness struggles to permeate even in the cultural and creative industries, which, although often seen as "cool" and egalitarian (Gill, 2002), are still characterised by serious gender inequalities (Conor et al., 2015; Barca, 2018).

1Among them the Report of the International Labour Organization (ILO, 2019), which shows how the companies with a good level of gender equality in the workforce and in top positions achieve, in addition to better profitability and labor productivity, a general improvement in business of enterprise. In fact, the study highlights how female leadership leads to a greater ability to attract and retain talent, higher levels of innovation, an improvement in corporate reputation, a better ability to evaluate consumer interests.

An analysis of the most recent data from the Internet Movie Database (IMDBb)[2] shows that, in the audiovisual industry, women account for no more than 34% of the total workforce. This gender gap testifies to the persistent presence of an "inequality regime" (Acker, 2006), embedded in organisational structures, which is strongly influenced by the role expectations imposed by the creative and cultural sector and, more generally, by society. The interaction of such expectations with the sector's working practices thus produces and reinforces specific gender roles and professions, which inevitably affect access to resources and the relevant market (EENCA, 2020) (Figure 1).

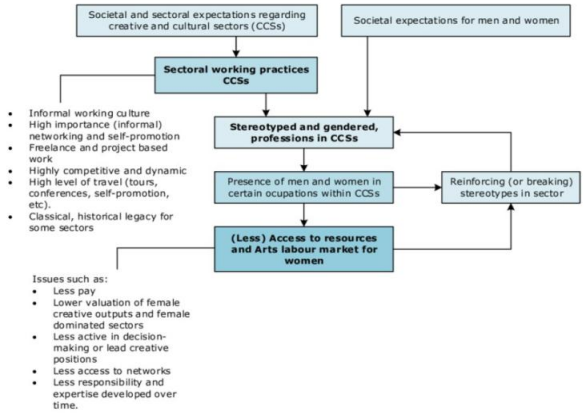

Figure 1: Gender gaps in the Cultural and Creative Sectors: The Audiovisual Sector
Source: EENCA (European Expert Network on Culture and Audiovisual), 2020.

This is a dense network of gender stereotypes and prejudices that contributes to creating segregation of a horizontal nature, confining women within specific fields in which they are believed to best express the skills attributed to them (Hesmondhalgh and Baker, 2015), and of a vertical nature, leading women to occupy top positions less often than men, as shown by the latest research published by the European Audiovisual Observatory (2022) (Figure 2).

2 This is the largest and most internationally accredited archive for collecting information in relation to films, actors, directors, production personnel and television programs (as well as video games, video clips and TV commercials), which, starting from 2017, has equipped with a new classification (F rating) aimed at grouping films that are written or directed by women, or in which women are protagonists or really relevant in the plot.

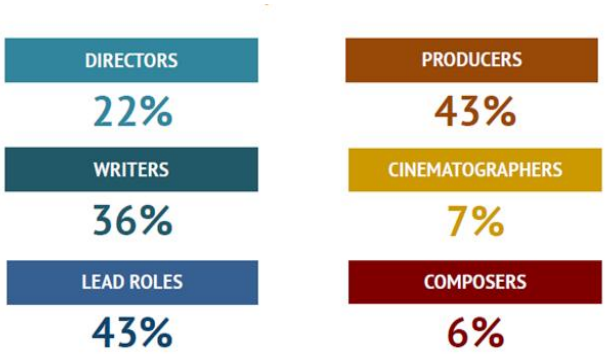

Figure 2: Women represented among active professionals of European TV works 2021
Source: European Audiovisual Observatory/LUMIERE, Plurimedia, 2022.

The same trends emerge from the analysis of the Eurimages document on gender equality (Gender Equality Strategy 2021-2023), which underlines how, despite the efforts made by Member States, including Italy, the gender gap in audiovisual production is still significant. This has required the introduction of more drastic and incisive interventions, unbalanced in favour of *female-driven* projects, encouraging greater female participation in both creative and technical roles and supporting initiatives that upgrade the entire audiovisual sector.

These and other incentives have undoubtedly contributed in recent years to a general improvement of the situation in the sector: from managerial appointments to new recognition paradigms, inclusion is progressively making its way onto the agenda of the audiovisual world, together with a more consistent enhancement of women as managerial figures (Giancipoli, 2022). The number of female-led or predominantly female-led initiatives in our country grew in 2021 (by 19%), as did the number of female directors under 35 (an increase of 6 percentage points compared to 2020). Alongside these positive trends, there is also the share of women involved in screenwriting and editing, which stands at 30% and 28%, respectively, with an overall growth of 4% compared to the previous year (MIC, 2021). As Marta Donzelli, president of the Centro Sperimentale di Cinematografia, emphasises –*"the critical core of the issue is that of decision-making processes: where gender parity is achieved in top positions, the climate changes and the balance shifts, not because women choose women but because the diversity that opens up difference is brought into play, producing different decisions"* (MIC, 2022).

This new awareness is making its way through the entire supply chain of the audiovisual world, also thanks to organisations and associations committed to enhancing the female presence in the audiovisual sector, including the Italian

division of WIFTM (Women in Film, Television and Media). As Domizia De Rosa, President of WIFTM, pointed out, it is indeed necessary to extend the count of creative roles also to a statistic of managerial roles to allow a broader understanding of the participation of female professionals: producers, managers, presidents or CEO's who are an integral part of the design and entrepreneurial development of productions.

3 Methodology

The present paper is supported by a face-to-face survey qualitative methodology. The qualitative survey research method fits in the main five qualitative research described by Creswell, 1998 as: biography, phenomenology, grounded theory (Glaser and Strauss, 1967), ethnography and case study (Yin, 2009). Particularly, qualitative survey analyses are inductive indeed, and it is, first of all, a simple research design, not for the study of social structures and processes but for the study of diversity in a population (Jensen, 2010), like the context that authors intend to investigate. In fact, the research aimed to investigate the relationship between women and soft power in the main Italian audiovisual companies through 16 in-depth interviews (Kvale, 1996) with representatives of Italian media companies3. The purpose of these interviews was to identify the point of view of female professionals in the audiovisual sector. To obtain an external point of view, male testimonies were also considered. The approach was aimed at capturing their opinions, shaped by the professional role they hold and their personal and professional experiences to understand the extent to which women's social, psychological, cultural, and economic conditions influence organisational and production processes and the quality of the media narratives produced.

It was decided not to dwell on women facing significant job insecurity in the media production system but to focus on overcoming gender inequalities by enhancing soft skills. Furthermore, the choice of interviewees, both women and men who hold significant positions in the media companies analysed, was also geared towards favouring a project approach and emphasising the added value of women's presence in television productions regarding soft power.

3 In-depth interviews took place between December 2020 and December 2021. The interviewees belong to the following media companies: RAI, Mediaset, Fascino PGT Srl, Aurora Film&Tv, Stand by Me.

4 Results - Enhancing the soft skills of female leadership for a new positioning of the audiovisual sector

This section is devoted to answering the main research question (RQ1) of the work: how women's leadership can support audiovisual companies in reaching sustainable development?

In light of the interviews, the analysis suggests enhancing the soft skills of female leadership for a new sustainable positioning of the audiovisual sector. Particularly, the research shows how gender still significantly influences the working environment and how being a woman is often perceived as disadvantageous. This can be identified by certain tendencies highlighted by many of the women interviewed, such as the astonishment when a woman is elected to a professional role of great prominence and responsibility or when she is the only woman in work meetings. Furthermore, motherhood continues to be seen as a disadvantage, showing how women's work and relationship needs still represent a site of competitive tension between professional achievements and family roles (Liddy and O'Brien, 2021).

The perspectives of many of the professionals interviewed, therefore, converge in the view that motherhood creates obstacles for working women, that the environment of the Italian audiovisual industries is predominantly male, and that women have had to work much harder than men to establish themselves, earning less on equal terms (World Economic Forum, 2021). However, Italian public service broadcasting has undergone many changes over the last ten years, especially when female managers have stepped in. Annamaria Tarantola's presidency represented a real turning point in this respect, making RAI the first European public service company to have a gender policy.

Along the same lines are other testimonies – also inherent to the commercial networks – which highlight how it is precisely the ability to reconcile domestic life and professional responsibility that characterise Gina Nieri, director of the Board of Directors of Mediaset, defined as a complete person, with an outstanding balance, very authoritative for personal competence, history and professionalism, which she accumulated over the years. In other words, in the opinion of the interviewees, it is the more numerous presences of women in managerial roles and responsibilities that leads to a better understanding of the female condition, improving the quality of life of women involved in the audiovisual production processes and, more generally, favouring a positive change in the organisational climate to the benefit of all.

The need to find a balance between personal and professional spheres is supported across the board by respondents who recognise that, without family support, reconciling professional and personal life, especially in relation to motherhood, would be almost impossible: *"The family network was really very present, and has helped me manage it. Without help, it would not have been possible"*.

A concrete example of the importance attached to the value of empathy, understanding and mutual support can be seen in the case of the managing director of Stand By Me, who is able to convey her own value framework to all the employees of the company and who are called upon to act as bearers of these values. As Stand by Me's chief entertainer reports: *"She entices you, she does not implement any psychological subterfuge to ensure that then your desire to become a mother is curbed by wanting to make a career, and this also becomes a male issue because consequently it also sensitises men"*. Considering motherhood as a human and professional value, focusing on reciprocal support, is useful in companies to create stronger bonds - men also understand, respect, and appreciate the work of mothers, empathising with situations that facilitate differentiated, creative, and inclusive work environments.

A similar situation concerns Fascino PGT Srl. According to the interviewees, its pink imprint derives from the fact that the company was born with Maria De Filippi, who has always been surrounded by female collaborators who have absorbed her approach. Hence the presence of female figures in crucial roles in many of Fascino's programmes, with whom the men are called upon to make the main decisions. This presence fits in well with the characteristics assumed by the current, strongly expanding television offer that has seen the birth of some thematic channels explicitly focused on a female audience. With respect to this offer, the presence of female authors is fundamental to establishing a relationship with the audience marked by empathy, and loyalty, and to guarantee greater involvement. Having women at the top of the company is therefore a huge advantage, as women are distinguished by strong attention to detail and nuance, and a high degree of sensitivity.

The Mediaset interviewees also deal with the theme that women are more sensitive than men due to a greater propensity to listen and to manage several jobs at the same time, even with different criticalities and problems: *"The difference in this exists, without being a feminist. The value of diversity lies in this"*.

The great challenge for many women in the audiovisual sector is to enhance soft skills related to sensitivity, training, collaboration, and responsibility within

predominantly male areas, not only to bridge the gender gap discussed above but to implement a different management approach oriented towards innovation and sustainability. In this perspective, one cannot but agree with the director of RAI Fiction when she states that it is essential for women to deal with the organisation, budget and management of audiovisual industries in order to assert themselves: *"If you do not know the management of an industry, you cannot carry it out, you can also be a very good intellectual, a fine writer, but who makes you enter the real focal points of movements, of organisations, is management"*.

Supporting women audiovisual workers and their empowerment – according to RAI's entertainment day-time director and coordinator of the European "No Women No Panel"campaign4 – presupposes first and foremost a joint effort, by individuals and institutions, to promote a true gender balance in public contexts and professions.This is because women not only have a high level of education, experience, and competence equal to that of men, but also soft skills capable of creating more inclusive opportunities for all in a strategic sector, capable of powerfully influencing imaginations and, consequently, the positioning of our country on the world stage. Hence the importance of supporting talented women emerging around the world, providing them with the training and job opportunities needed to give them a voice.

5 Conclusions

The proposed study starts from the awareness of a lack of literature regarding studies on the "behind-the-line" issues (Couldry, 2003), which represent the key factors for this type of industry (Buonanno, 2008, 2020; Gavrila, 2014; 2023). Amongst these factors, it is undoubtedly possible to identify Soft Power since the audiovisual sector represents an area in which the industrial and cultural aspects are closely interconnected and the decisions taken at the educational, organisational, and legislative levels have the capacity to decisively influence individual and collective imaginaries.

To understand how these soft skills are managed and what kind of impact they have at the level of diversity management, it is crucial, on the one hand, to consider the relationship between the use of this "soft" power's ability to use persuasion to change minds and influence behavior and which finds its primary

4 The memorandum "No Women No Panel - Without women we don't talk about it" commits the public television company to include female and male presences in the debates as equally as possible. RAI participates in the change of a system of representation of reality and information completely deranged by joining the initiative, started by the European Commission and initially endorsed by Radio RAI Uno, for an equal and balanced gender representation in communication activities.

sources in culture, political values and positive global commitment, and women managers in the audio-visual sector on the other. This is also with a view to promoting a better positioning of Italian audio-visual production in the national and international markets.

Indeed, many studies (Milestone and Meyer, 2012; Hesmondalgh, 2017) have shown that the lack of gender, ethnic, and religious diversity in audiovisual professions leads to offensive and inappropriate narratives and/or a decrease in the amount of representation of these socio-cultural categories. Often the result of stereotypes and inappropriate representations is precisely discrimination against certain social groups, including women, beginning with staff selection practices (Jones et al., 2017). This unbalanced presence of diversity in production environments also has a negative impact on the interpretation of this plurality of identities in media texts (O'Brien et al., 2016; Gavrila and Parziale, 2018).

Starting from the general Italian situation regarding gender inequality, this study points out the extent to which gender influences the career trajectory of audiovisual professionals and the capacity for soft power. Moreover, it offers an insight on how female competence is perceived within media organisations in the Italian context, with particular attention to roles, creativity, and decision-making process. Underlying the need of creating more inclusive opportunities for all in a strategic sector, and powerfully influencing imaginations and the soft-skills.

This study has several theoretical and practical implications. Theoretically, it enriches the literature on gender studies and deals with various aspects of sustainable development and diversity management in the company. From a practical point of view, it highlights the main characteristics of transversal competencies that female leadership must fulfil to achieve sustainable development for the company. In this perspective, the audiovisual sector is a driving factor for narrating positive role models. This starts with specialised training to introduce new professional figures in this field, given how access passes through an imaginary of skills and possibilities. It is, therefore, a matter of adopting a different approach, capable of looking at the different professions operating in the audiovisual sector, including creative and managerial roles.

Finally, using an intersectional lens should be a general key, capable of considering, in addition to gender, the different social identities that systematically contribute to discrimination, hindering the formation of true leadership positions (EENCA, 2020). Hence the need for a set of initiatives (such as the support to *female-driven* projects) that can have a long-term impact, also in terms of diversity and sustainability, through the enhancement of a female Soft

Power, for a new positioning of the Italian audiovisual system, and of our country, on the international scene.

6 Limitation and Future research perspective

The main limitation of the research could be recognised to the number of interviews conducted. In fact, the future lines of research aim to expand the survey, also considering international entities. This perspective will help the authors identify the main characteristics of women managers allowing the audiovisual companies to reach the best outcome format for the market. Moreover, extending the analysis could promote the generalisation of the main findings of the research.

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The Role of Digitalization in the Sustainable Business Model: A Content Analysis of Integrated Reporting of European Companies

Ferdinando Di Carlo

University of Basilicata
Via Dell'Ateneo Lucano
85100 Potenza, Italy;

Manuela Lucchese

University of Campania "Luigi Vanvitelli"
Corso Gran Priorato di Malta
81043 Capua, Italy;

Raffaele Adinolfi

University of Basilicata
Via Dell'Ateneo Lucano
85100 Potenza, Italy;

Silvia Solimene*

University of Basilicata
Via Dell'Ateneo Lucano
85100 Potenza, Italy;

** Corresponding author*

Abstract

The topics of sustainability and digitalization are increasingly present in contemporary academic, economic and social debates. Both topics are drastically changing the behaviour of companies. This article aims to examine the disclosure of information on digitalization and sustainability in the context of the Integrated Report of European companies. It seeks to understand the extent to which these companies are moving towards a sustainable business model (SBM) that includes new digital technologies. In particular, the analysis started from the systematic literature review proposed by Broccardo et al. (2023) who, in order to investigate the contribution of new technologies to the transformation of companies' SBM, provides a new table of categories started by the Business Model Canvas. Based on this framework, the authors constructed the useful items to develop and test the research objective. For this purpose, the qualitative research method was chosen. In detail, an automatic content analysis was conducted. This work analysed the Integrated Reports

using a sample of 125 European companies in the period 2020-2021. The results showed that companies are increasingly including digitalization and sustainability issues in financial and non-financial reports. However, the financial sector seems to include digitization issues more closely, while the non-financial sector includes sustainability issues. Although studies in this field are increasing considerably, it seems that the academic debate is still in its infancy and that there are not enough empirical studies. To fill this gap, this article can contribute to the existing literature and provide an element of support for academics, companies and standard setters.

Keywords – Sustainable Business Model, digitalization, integrated report, disclosure

Paper type – Academic Research Paper

1 Introduction

The paper aims to investigate the disclosure of information on digitalization and sustainability in relation to the financial and non-financial reports (NFRs) of European companies. The study proposes an analysis to understand whether key issues related to digitalization and sustainability, are disclosed in the Integrated Report of European companies, and if so which ones. The scope is to try to understand the level of migration of these companies towards a Sustainable Business Model (SBM) (Stubbs and Cocklin, 2008; Garetti and Taisch, 2012; Boons and Lüdeke-Freund 2013; Evans et al., 2017) that includes new digital technologies.

New digital technologies, such as the Internet of Things, big data and its analysis, virtual and augmented reality, are revolutionising society today (Acciarini et al., 2021) and radically changing the way companies produce or provide services, facilitating their transition towards sustainability (Bressanelli et al., 2018; Broccardo et al. 2023). In recent years, the issues of sustainability and digitalization have been the biggest and most significant challenges that companies, in particular, are facing. The connection between these two areas shows extraordinary, as yet untapped, opportunities to promote a transformation towards sustainable development (Del Río Castro et al., 2021). Sustainable development (SD) is generally defined as meeting the needs of the present without compromising future generations from an economic, social and ecological perspective (WCED, 1987). The requirement to also implement the social and environmental dimension in the overall 'modus operandi' of companies has resulted in them increasingly moving towards the development of Sustainable Business Models (SBMs). Companies are becoming more aware that the sustainability of their business model (BM) is a key success factor (Acciarini et al.,

2021). Indeed, according to Broccardo et al. (2023:2) SBMs provide a promising theoretical framework for identifying how firms design and implement innovations that lead to further improvements in sustainability performance. In this process, many authors agree on the supporting role that digitalization offers in achieving sustainability goals. For instance, Fernandez-Portillo et al. (2019) emphasised the enabling role of digital paradigms; for Atos (2019:8), digital technology is fundamental to the concept of the circular economy for both mapping, organising, controlling and ensuring consistency throughout the chain, while Andreopoulou (2012) argued the benefits of technology for environmental protection. What is certain is that '*a future without digital technologies is not imaginable, nor is a future in which sustainability discourses disappear*' (Lenz, 2021:190). Although studies concerning the relationship between digitalization and sustainability have increased exponentially, they are still in an embryonic state (Pagoropoulos et al., 2017; Dubey et al., 2019; Lenz, 2021). Specifically, to the best of our knowledge, there are still few research studies that include digitalization and the use of digital tools in the theoretical framework of the sustainable business model (Bressanelli et al., 2018; Tiscini et al., 2020; Acciarini et al., 2021; Broccardo et al., 2023).

The present study applies a qualitative research methodology based on automatic content analysis. The Integrated Reports (IR) published on the websites of European companies inserted in the International Integrated Reporting Council (IIRC) database were analysed, and a qualitative disclosure index about digitalization and sustainability has been developed. Then, this information was compared between different years and sectors to understand the analogies and differences by time and by sector. Moreover, this analysis allows an understanding of the effectiveness of IIRC guidelines in conveying potentially crucial information that can be used to evaluate a business model increasingly oriented towards sustainability concepts and digital transformation. To this end, the authors chose to analyse IR because "*it represents a tool capable of aligning governance aspects with corporate decision-making processes through socio-environmental impact assessments*" (Di Vaio et al., 2021:692). IIRC defines the Integrated Reporting as a document which "*brings together material information on the strategy, governance, performance and perspectives of an organization in a way that reflects the commercial, social and environmental context within which it operates. It provides a clear and concise representation of as an organization creates value, now and in the future"* (IIRC, 2011:2). In addition, according to Di

Vaio et al. (2021:706) the integrated model reaches its maximum expression in the creation of SBM for the creation of long-term value.

The results showed that companies are increasingly including digitalization and sustainability issues in financial and non-financial reports. However, the two themes do not yet appear to overlap and appear to be separate, although with some interconnections. In the sector analysis, the financial sector seems to embrace digitalization topics more, while the non-financial sector embraces sustainability topics.

This research contributes to the growing debate on the relationship between digitalization and sustainability by analysing the role of technologies in the sustainable business model framework. Furthermore, it contributes to filling gaps in the existing literature and aims to increase theoretical knowledge on the link between digitisation and SBM, in order to provide companies with valuable support in their decision-making process through the dissemination of practices and activities in this area in European financial and non-financial companies.

The paper is structured as follows: Section 2 presents the literature review on the relationship between the concept of SBM and digitalization. Section 3 illustrates the methodology and the sample investigated. Section 4 presents the results and conclusions.

2 Digitalization in the Sustainable Business Models framework

Sustainability and digitalization have been the megatrends at the forefront of political, economic, social and academic debate (Lichtenthaler 2021; Broccardo et al., 2023; Holzmann & Gregori 2023). Both trends have strongly influenced companies' behaviour to change progressively their business practices, strategies and processes.

Sustainability is a relatively broad concept and traditionally refers to the triple bottom line of financial, environmental and social outcomes (Elkington, 2018). In light of the Covid-19 emergency, the recent war in Ukraine and the growth of the global economy, all organisations are under increased pressure to take sustainability into account in their business models (BMs). The concept of BM emerged mainly with the advent of the internet in the 1990s (Yip, 2014; Teece, 2010) and academic literature deals extensively with this concept providing numerous definitions (Magretta 2002; Zott and Amit, 2010; Teece 2010; Osterwalder and Pigneur 2005, 2010; Beattie and Smith 2013). Some authors define BM as the logic of "*how an enterprise does business*" (Magretta 2002; Teece 2010). Others, broadly associate the concept of BM with the concept of value

creation (Richardson 2008; Osterwalder and Pigneur 2010; Lüdeke-Freund, F., 2013; Bocken et al., 2013). Richardson (2008) proposed a framework for BM consisting of three elements: value proposition, value creation and delivery and value capture. These elements are also included in the definition proposed by Bocken et al. (2013). Lüdeke-Freund (2013) suggested a framework composed of four elements: value proposition; supply chain; customer interface; and financial model. Osterwalder and Pigneur (2010) developed the most famous framework, the so-called Business Model Canvas, which contains nine blocks: value proposition, customer segments, customer relationships, channels, key partners, key activities, key resources, cost structure and revenue streams.

The need to integrate sustainability into BMs becomes the biggest challenge for companies and requires a more holistic understanding of the concept of value, which must include the creation of social and environmental value (Schaltegger et al., 2012). To this end, the concept of a sustainable business model (SBM) has emerged (Stubbs and Cocklin, 2008). In recent years, academic interest in SBM has grown rapidly and many authors tried to provide a general definition (Boons and Lüdeke-Freund 2013; Bocken et al. 2014; Schaltegger et al. 2016; Evans et al. 2017). For instance, to Schaltegger et al. (2012:112) SBM *"creates customer and social value by integrating social, environmental, and business activities"*. Geissdoerfer et al. (2018:404) conducted a literature review on this topic and defined SBM as *"business models that incorporate pro-active multi-stakeholder management, the creation of monetary and non-monetary value for a broad range of stakeholders and hold a long-term perspective"*. According to Geissdoerfer et al. (2018:403), the common element of the definitions in the literature is that they see SBMs as a modification of the conventional BM concept. This modification can be translated by adding concepts, principles or objectives that aim at sustainability or integrating sustainability into the value proposition, value creation and delivery activities and/or value capture mechanisms.

In this context, a number of scholars (Joyce et al., 2016; Jones and Upward, 2014; Fichter and Tiermann; 2015) have attempted to adapt the traditional BM Canvas, which is mainly oriented towards economic aspects, to the necessary integration of social and environmental aspects. Joyce et al. (2016) extended the traditional BM Canvas by adding two levels, the environmental and the social layer. In addition to the economic structure of the traditional BM Canvas, the authors proposed two other models of BMs by constructing them from a social and environmental perspective. This innovative approach is called the Triple Layer Business Model Canvas. Cardeal et al. (2020), in the same vein, proposed a new

business model canvas for sustainability (BMCS) and an evaluation method to assess it. The difference between the other models is the tripartition of each of the nine blocks that includes all dimensions of sustainability. Indeed, each element of BM Canvas is translated in an ecological and social point of view. They also validated this model with an industrial case study, which showed significant results although it requires further investigation (Cardeal et al., 2020).

Currently, also the phenomenon of digitalization offers the potential to create new SBMs impacting the overall strategy, choices and actions of firms (Capurro et al., 2023). The author Vial (2020:118) defines digitalization as *"a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication and connectivity technologies"*. Verhoef et al. (2021) through their study of the existing literature, divide the digital process into three phases: digitization, digitalization and digital transformation. Digitization expresses the changing of information from analogue to digital format; digitalization refers to the role that digital technologies play or can play within the processes and activities of companies; digital transformation is the most pervasive phase and describes how the whole company, thanks to technology, can move towards new business models. Researchers have focused on studying digital actions in specific disciplines, e.g., banking (Bernini et al., 2021), marketing (Lamberton et al., 2016) or healthcare services (Agarwal et al., 2010).

Nowadays, businesses are realising that sustainability and new digital technologies offer a wide range of possibilities (Capurro et al. 2023). Understanding the increasingly influential role of digitalization in the framework of sustainability is vital (Broccardo et al., 2023:2). However, the role and influence of digitalization in the implementation of SBMs have not yet been studied in detail, despite its growing importance (Dubey et al., 2019; Bressanelli et al., 2018; Nobre and Tavares, 2017; Pagoropoulos et al., 2017).

Indeed, few authors have conducted analyses on SBM in order to analyse the link between sustainability and digitalization. Some studies are industry-specific (Watanabe et al., 2018; Fiorentino et al., 2020), while others have focused on specific digital technologies (Del Mas et. al., 2020a; Tiscini et al., 2020; Pizzi et. al., 2021). For instance, Di Vaio et al. (2020) analysed the role of artificial intelligence in the implementation of SBM; Del Mas et al. (2020) focused on blockchain technology as a tool to support SBM; Annosi et al. (2020) studied the same relationship in the agricultural sector. Acciarini et al. (2022) through the analysis

of the automotive sector, explains the role of digitalization and sustainability in the innovative business model of companies.

Broccardo et al. (2023) through a literature review analysed the link between digitalization and SBM, illustrating the potential impact of digital tools for each element of the model proposed by Osterwalder and Pigneur (2010). Starting from the BM Canvas, the authors identify the elements through which digitalization can influence each SBM block. The blocks most involved in the digital process, leading to the integration of sustainability in the BMs, turn out to be key partner, activities, resources, channels, and customer relationships. The results of this research show that the unanimity of the analysed studies recognises the supporting role that digital technologies play in the implementation of a sustainable business model. In particular, most of them emphasise its enabling role, others the beneficial effect alone. However, although the positive impact that digitization has on sustainability is always emphasised, its negative aspects must also be considered. Some authors mention among negative effects, the degradation of the natural ecosystem, the increase of information asymmetries and digital divides. For instance, Saunila et al. (2019:184) analysed the relationship between smart technologies and corporate sustainability shown that the environmental and social returns from smart technologies are not self-evident, and smart technologies alone are not sufficient to generate environmental and social sustainability.

3 Methodology and research design

To analyse the content of the European companies' IR this study adopts a content analysis method, which is defined as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (Krippendorff, 2004:16). This tool enables a large amount of information to be collected in a systematic, objective and reliable manner (Guthrie & Parker, 1990; Guthrie et al., 2004). It is required to codify the information to be investigated using predefined categories (Guthrie et al., 2004; Guthrie & Abeysekera, 2006; Cinquini et al., 2012). According to Cho and Hambrick (2006:459), the methods assume that words or phrases "frequently used are cognitively central and reflect what is most on the user's mind". In a similar context, many authors use this method in prior disclosure studies (Hossnofsky & Junge 2019; Bernini et al., 2021). In order to assess the presence of digitisation-related terms within the theoretical framework of the SBM, the analysis was constructed in several steps.

First, to build the dictionary, the framework proposed by Broccardo et al. (2023) has identified the list of the information items about digitalization inserted in SBM's context. Broccardo et al. (2023), through a literature review, identified the new opportunities that digitisation can bring to each SBM block, starting with the nine blocks of the Business Model Canvas proposed by Osterwalder and Pigneur (2010). The elements identified by this work represented for analysis the key elements for the construction of our dictionary, i.e. a list of words associated with a given category. Using this SBM, we grouped such drivers into different nine categories, and nine dictionaries were constructed, one for each block: key partners, key activities, key resources, cost structure, value proposition, customer segments, customer relationships, channels and revenue stream. In total, the final dictionary (see Table 1) contains 722 words, when including all word variations of these keywords.

Table 1 - Information Items about Broccardo et al. (2023)'s framework

Categories	Word's dictionaries
Key partners	key*[1] partner*, new online partner*, new online partner†[2], opportunities to share among partner, opportunities to share among partners, more opportunity* to share among partners†, ecosystem for creation improved†, stakeholder engagement facilitated†, new investor*, entrepreneurship democratized lower barriers for entrepreneurs†, barriers for entrepreneur*, involvement by local authorities and prosumers facilitated†, digital*, digitization*, digitalization*, digital transformation*, digital technology*, digital tool*.
Key activities	key activity*, more efficient logistic*, efficient logistic*, remanufacturing facilitated†, remanufacturing, reusing facilitated†, reusing, recycling facilitated†, recycling, more automatized processes†, automatized process*, more efficient transactions†, efficient transaction*, digital*, digitization*, digitalization*, digital transformation*, digital technology*, digital tool*
Key resource	key resource*, resource*, use of instore technology†, instore technology, technology*, digital technology*, digital tool*, resources easier to share†, use of renewable resources and raw materials†, renewable resource*, raw material*, more efficient use of resources and capabilities†, time reduction*, digital*, digitization*, digitalization*, digital transformation*
Cost structure	cost*, cost structure, improved cost structure due more efficiency†, more research and development investments†, research and development investments†, lower costs per unit†, costs per unit, more R&D†, more research and development, research and development, R&D, digital*, digitization*, digitalization*, digital transformation*, digital technology*, digital tool*
Value proposition	value proposition*, customized products and service†, servitization*, virtual and dematerialized products†, virtual, virtual product*, dematerialized product*, dematerialization, sustainable and smart products†, sustainable product*, sustainable product†, smart product*, new value proposition*, more information to customers†, information to customers†, opportunities of value co-creation with consumers†, opportunities of value co-creation†, potentially cheaper products†, cheaper product*,

*1 *Words marked with this symbol were also considered in plural form.*

2 † Keywords marked with this symbol were also entered in the dictionary individually.

	circular economy increase†, circular economy*, CE, digital*, digitization*, digitalization*, digital transformation*, digital technology*, digital tool*
Customers segments	customer segment*, new customer segments for sustainable and smart products†, customer segment for sustainable and smart product†, surge of prosumer†, prosumer*, consumer*, digital*, digitization*, digitalization*, digital transformation*, digital technology*, digital tool*
Customer relationship	customer relationship*, closer relationship*, longer run relationship†, opportunities for co-creation†, more legitimacy vis-` a-vis consumers†, legitimacy, asset sharing among clients†, asset sharing, better grasp of customers' needs†, need of customer*, relations based on social proof†, social proof*, higher social trust*, social trust*, fostering of good behavior*†, fostering of good behaviour†, good behaviour*, relationship facilitated via platforms or apps†, platform or app*, community building†, community*, digital*, digitization*, digitalization*, digital transformation*, digital technology*, digital tool*
Channels	channel*, online sales†, lower transaction cost*†, transaction cost†*, vertical integration facilitated†, more use of digital sale platform*†, digital platform*, omni channels strategies†, shared infrastructure*, digital*, digitization*, digitalization*, digital transformation*, digital technology*, digital tool*
Revenues flow	revenue*, revenues flow*, flow, new revenue streams due to servitization†, stable revenues due to servitization*, more licensing*, licensing, digital*, digitization*, digitalization*, digital transformation*, digital technology*, digital tool*

Second, has been used companies' IR to apply the dictionary. The authors chose to analyse the Integrated Reports of the selected companies as they provide additional information about corporate strategy, governance and performance, and combine financial and non-financial information in one document (Nicolò et al., 2019; Ciubotariu et al., 2021). The content elements of the IR are fundamentally interconnected and are presented in a way that makes the interconnections between them evident, rather than as isolated, stand-alone sections (Fundation, V. R., 2021). Moreover, one of the elements in the IR Framework is specifically related to the business model's information.

Third, the coding process was performed through automatic content analysis, thanks to a special tool, called Lexos v4.0 2019 Wheaton Lexomics. This automatic method is considered superior because is faster and more consistent than manual techniques in the coding process (Kondracki et al. 2002:226). The Lexos software is a web-based tool which is capable of different types of text analysis and representation and allows us to digitize massive numbers of texts so that they can be understood visually (Peterson 2015:63). The software provided us with the absolute number of words in the dictionaries, which, when compared to the total number of words in the documents, represents an index by which to assess the degree of migration of the business model towards issues such as sustainability and digitalization.

As previously seen in other studies (Tavana et al., 2022; Yang & Deng, 2023), the disclosure index adopted to analyse the frequency of words in the dictionary in the companies' IR, we used the ratio between the frequency of words in the SBM framework provided by Broccardo et al. (2023) in the integrated report and the number of total words.

$$SBM\ towards\ digitalization\ index = \frac{Total\ number\ of\ dictionaries'\ keyword\ frequencies}{Total\ number\ of\ word\ in\ the\ IR}$$

In addition, to further validate our dictionary, we collected the most frequently used words and phrases in the financial and non-financial sectors by year.

3.1 Sample

The empirical analysis of the level of digitalisation disclosure in SBM in Integrated Reporting was conducted on a sample of 161 European companies. These companies were selected from the "Integrated Reporting Examples Database", which aims to provide an online resource for organisations that are developing, or planning to develop, Integrated Reporting. When selecting the companies to be analysed, the focus was on the IR based on the framework which has been designed based on the IIRC or the one within which there are references to it. Only European companies were selected from the database. Therefore, the websites of all 161 companies were analysed. Accordingly, to the aim of this study, we selected just the documents denominated IR and Annual Report published in English and downloaded in pdf extension. Among these, for applying the content analysis, we considered the last IR and Annual Report published by the companies in the two years 2020–2021. Of the 161 European companies selected, only 125 (78%) met the requirements for the analysis: some companies were discarded because they did not submit the report for the selected years, or because the report was in a different language. A total of 250 documents were analysed, of which 125 were for the year 2020 and 125 for the year 2021.

4 Results and conclusions

A first assessment of the results can be conducted with the average values of the word frequencies in each block of the digitalization oriented SBM framework (see Table 2). The average was calculated by considering the word frequency for each block divided by the number of companies in the sample. These values were

reported for both the year 2020 and the year 2021 to capture the possible increase in the use of this terminology over time.

Table 2 – Average value of word's frequencies

Categories	Averages_2020	Averages_2021
Key partners	30.4	30.5
Key activities	32.5	33.1
Key resource	83.9	87.3
Cost structure	100.0	100.6
Value proposition	37.4	37.5
Customers segments	33.0	32.7
Customer relationship	66.1	65.0
Channels	144.8	144.9
Revenues flow	122.8	124.0
Word Count	721700.1	729943.8

As the above table shows, the categories or blocks with the highest average value are Channels (144.8) and Revenue flow (122.8). How the product or service is delivered to customers is the focus of the channel's element of the Business Model Canvas (Osterwalder and Pigneur, 2010). Such a result is expected because, from a digital point of view, the use of digital channels and platforms have become indispensable for several types of companies (Broccardo et al., 2023), especially to build safe customer relationships. Moreover, digital platforms bring in new revenue corresponding to additional services, effectively increasing the revenue stream (Broccardo et al., 2023). More specifically, digital technologies could open up new possibilities in logistics and distribution, or be seen as an increasingly important sales channel, but also as a means of supporting the adjustment of cost structures (Capurro et al., 2023). While, contrary to expectations, the category with the lowest average value is that of Key Partners. Key partners are stakeholders who are directly involved in the early stages of the company's core activity (Cardeal et al., 2020). Digital transformation changed the business processes and the interactions between firms and their external partners (Ashok, 2018) and allow for reaching new investors (Broccardo et al., 2023). In general, these initial results also show a slight increase in the averages from one year to the next. This is probably due to the increasing use of these terminologies in the business environment. However, a lower average is evident in the categories 'Customer segment' and 'Customer relationship'. For instance, in some

companies, it is interesting to note that within the category 'customer relationship', there is a marked decrease in the presence of the words "community*" or "consumer*".

Table 3 shows the value of the SBM towards digitalization disclosure index calculated from the frequency of keywords in the Integrated Reporting of the selected companies.

Table 3 - The categories of SBM towards the digitalization disclosure index

Companies	2021_Index	2020_Index	Companies	2021_Index	2020_Index
X_1	0,525‰	1,011‰	X_64	0,679‰	0,675‰
X_2	2,041‰	1,59‰	X_65	0,005‰	0,026‰
X_3	0,772‰	0,896‰	X_66	1,065‰	1,027‰
X_4	0,829‰	1,047‰	X_67	0,623‰	0,611‰
X_5	1,828‰	1,32‰	X_68	0,652‰	0,898‰
X_6	0,357‰	0,378‰	X_69	0,595‰	0,593‰
X_7	0,868‰	0,588‰	X_70	0,691‰	0,875‰
X_8	0,715‰	0,784‰	X_71	0,989‰	1,082‰
X_9	1,105‰	1,081‰	X_72	1,109‰	0,841‰
X_10	0,582‰	0,637‰	X_73	1,026‰	0,977‰
X_11	0,844‰	0,829‰	X_74	1,09‰	1,198‰
X_12	1,031‰	0,834‰	X_75	0,759‰	0,574‰
X_13	1,095‰	1,054‰	X_76	1,027‰	1,033‰
X_14	2,631‰	1,359‰	X_77	0,415‰	0,373‰
X_15	0,558‰	0,579‰	X_78	0,785‰	0,695‰
X_16	0,872‰	1,004‰	X_79	1,705‰	1,497‰
X_17	0,839‰	0,954‰	X_80	1,188‰	1,167‰
X_18	0,788‰	0,67‰	X_81	2,191‰	3,003‰
X_19	0,495‰	0,99‰	X_82	0,756‰	0,841‰
X_20	3,981‰	2,984‰	X_83	0,805‰	1,05‰
X_21	0,317‰	0,962‰	X_84	1,408‰	1,048‰
X_22	0,992‰	0,85‰	X_85	0,485‰	0,45‰
X_23	1,245‰	1,103‰	X_86	1,254‰	0,278‰
X_24	0,049‰	0,053‰	X_87	0,77‰	0,988‰
X_25	0,586‰	0,614‰	X_88	2,058‰	1,953‰
X_26	1,132‰	0,991‰	X_89	0,594‰	0,714‰
X_27	1,075‰	1,198‰	X_90	0,804‰	2,193‰
X_28	1,712‰	1,973‰	X_91	0,852‰	0,837‰
X_29	0,546‰	0,59‰	X_92	1,094‰	1,493‰
X_30	0,785‰	0,778‰	X_93	9,912‰	3,529‰

X_31	0,772‰	0,834‰	X_94	1,617‰	1,348‰
X_32	0,761‰	0,824‰	X_95	1,118‰	1,53‰
X_33	0,389‰	0,465‰	X_96	0,093‰	0,104‰
X_34	1,8‰	1,707‰	X_97	0,658‰	0,663‰
X_35	0,408‰	0,68‰	X_98	1,27‰	1,229‰
X_36	1,521‰	1,725‰	X_99	0,108‰	0,457‰
X_37	0,635‰	0,549‰	X_100	2,264‰	2,422‰
X_38	1,286‰	1,106‰	X_101	0,429‰	0,388‰
X_39	0,75‰	0,889‰	X_102	0,429‰	1,499‰
X_40	0,309‰	0,745‰	X_103	1,034‰	1,049‰
X_41	1,772‰	3,527‰	X_104	1,532‰	1,844‰
X_42	1,492‰	1,247‰	X_105	0,512‰	0,525‰
X_43	0,652‰	0,694‰	X_106	0,912‰	0,596‰
X_44	1,414‰	1,452‰	X_107	0,854‰	0,69‰
X_45	1,149‰	1,126‰	X_108	0,444‰	0,422‰
X_46	0,769‰	0,478‰	X_109	1,23‰	0,505‰
X_47	1,049‰	0,871‰	X_110	0,578‰	0,658‰
X_48	0,206‰	0,189‰	X_111	0,479‰	0,673‰
X_49	1,09‰	2,15‰	X_112	0,743‰	1,213‰
X_50	0,682‰	0,748‰	X_113	1,875‰	1,911‰
X_51	0,399‰	0,891‰	X_114	0,821‰	0,934‰
X_52	0,738‰	0,764‰	X_115	0,852‰	0,055‰
X_53	1,49‰	1,734‰	X_116	1,179‰	1,831‰
X_54	0,87‰	0,889‰	X_117	1,768‰	0,962‰
X_55	0,612‰	0,677‰	X_118	0,934‰	0,839‰
X_56	0,491‰	0,527‰	X_119	0,98‰	0,823‰
X_57	0,807‰	0,89‰	X_120	0,868‰	0,728‰
X_58	1,014‰	0,973‰	X_121	1,182‰	0,887‰
X_59	2,55‰	0,6‰	X_122	0,679‰	0,797‰
X_60	1,414‰	0,849‰	X_123	0,758‰	0,535‰
X_61	0,602‰	0,437‰	X_124	0,962‰	0,948‰
X_62	1,38‰	1,341‰	X_125	2,473‰	1,708‰
X_63	0,63‰	0,651‰			

The disclosure index shows moderate value: in the documents for 2021 only 48 companies show an index higher than 1‰, in 2020 only 44 companies. It is interesting to note that almost 50% of the companies in the sample show an increase in the index from one year to the next.

The frequency of the phrases in the dictionaries used at least once are shown in Figure 1.

The term 'circular economy' is very frequent in the documents analysed. Many authors see this concept as supporting companies in the operation of sustainable developments, also promoted through 'digital' (Bican 2020; Centobelli et al., 2020; Kirchherr et al., 2017). Indeed, other authors highlight the role of digital tools to enable or favour the circular economy by facilitating exchanges among different stakeholders.

The value proposition should define why a customer chooses a company over another and it is characterized by a combination of products and services that create value for a certain type of customer (Osterwalder and Pigneur, 2010:22). Indeed, the term is often found in the IR of companies. As Ashok, (2018:2) unveil digital transformation allows companies to create new value propositions and has changed the way that business is conducted, despite the potential risk. Moreover, digital technology can support firms in their collaboration with stakeholders to increase value co-creation. As a result, new business models can be created which allows for the formation of new business ecosystems with partners and customers. This concept is also supported by Volberda et al. (2021).

Some important considerations emerge from this graph. Firstly, the increase in the use of certain keywords from one year to the next is reconfirmed. Secondly, the dominance of sustainability-related terms such as 'circular economy' and 'sustainable products' is evident. According to Acciarini et al. (2021) the sustainability aspect predominantly emphasizes the opportunity to build a valuable network of stakeholders within the community.

On the other hand, the role of terms related to the concept of digitalization is also of significance. However, the concept of digitalization probably does not refer to the use of specific tools: in fact, we note that the terms 'digital tool', 'smart product' and 'virtual product' are not prevailing in the analysis. The use of digital platforms also seems not to be a popular element in companies' reporting. The link between digitalization and sustainability must be adequately recognized, for companies to fully understand how their BMs can be innovated to increase their value offering to all parties concerned, including society (Acciarini et al., 2021).

Finally, the analysis was also conducted by dividing the companies by sector (see Figure 2 and Figure 3). Out of 125 companies, 22 companies belong to the financial sector and 103 to the non-financial sector. To provide homogeneity in the analysis, the frequency of the number of keywords was divided by the number of companies, resulting in an average score.

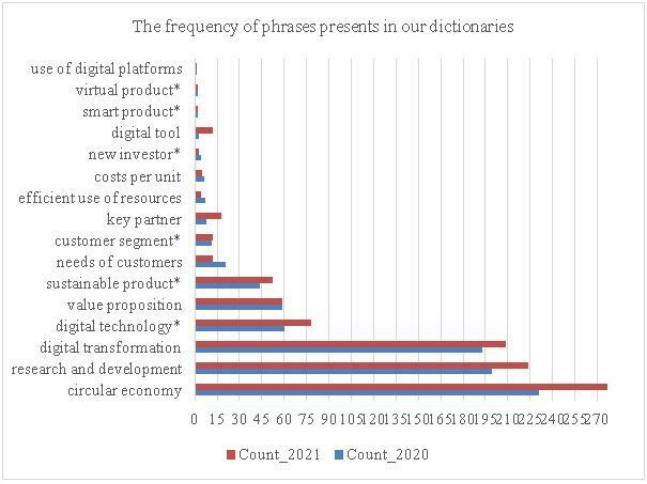

Figure 1 – The frequency of phrases presents in our dictionaries.

It is interesting to note that the words most found in documents differ according to sector. In the financial sector, the first keyword is 'digital transformation', while for the non-financial sector it is 'circular economy'.

This indicates that the financial sector and banks in general, are leaning more towards strengthening their digital transformation, in accordance with Bernini et al., (2021). Starting from this point, Bernini et al. (2021:1230) confirmed the efforts of banks to improve their digital initiatives. Despite this, the authors shed light on the need for greater disclosure to better balance the several types of information provided.

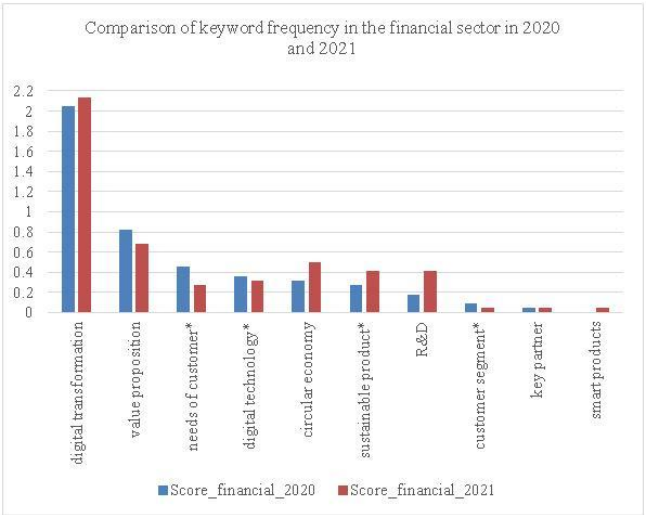

Figure 2 – Comparison of keyword frequency in the financial sector in 2020 and 2021

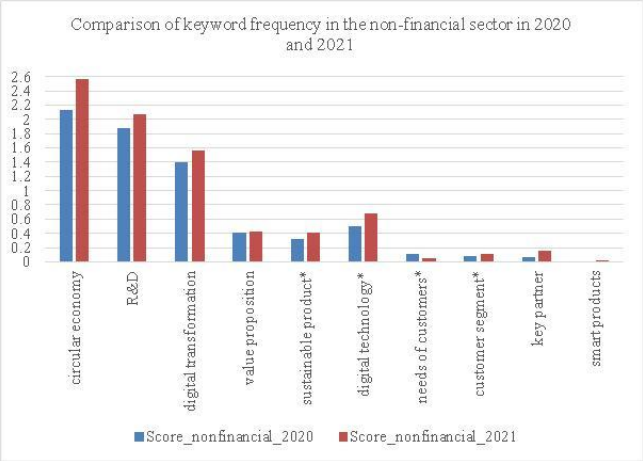

Figure 3 – Comparison of keyword frequency in the non-financial sector in 2020 and 2021

As far as the non-financial sector is concerned, the most frequently used terms are those referring to sustainability, in particular the 'circular economy'. Less attention, on the other hand, is paid to consumer needs and relationships. For instance, according to Bressanelli et al. (2018), companies may improve the design of their products, including through technology, in order to respond more effectively to consumer needs. Zorich (2020:14) states that the lack of digitalization and standardization of companies and business processes are the most critical challenges for Food Supply Chain sustainability, especially in the wholesale and retail segment. However, Capurro et al. (2023), through an analysis of corporate documents and press releases contained in the websites of companies belonging to the food and fashion sector, highlight the importance but above all the pervasiveness of digitalization and sustainability issues. Overall, the analysis shows how companies are increasingly moving to include digitalization and sustainability issues in their financial and non-financial reporting, which is also evidenced by the increase over the years in the frequency of terminology associated with these issues.

This exploratory research contributes to the growing debate on the relationship between digitalization and sustainability and is helpful in filling the gap in the existing literature. By analysing the role of technologies in the framework of the sustainable business model, it aims to increase theoretical knowledge in order to provide companies with a first valuable support in their decision-making process and to understand what their level of digitalization and sustainability is at the current stage.

Furthermore, we would like to acknowledge that the research we conducted was purely exploratory approach and may have some limitations. The first is represented by the sample, which could be extended to the international panorama, including more companies. The second limitation can be recognised in the choice of keywords included in the dictionary, which could be expanded in order to capture as much information as possible.

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The Credibility of Non-Financial Corporate Disclosure: Evidence from the Fashion and Luxury Sector

Alberto Dello Strologo

Department of Business Studies
Roma Tre University
Via Silvio D'Amico, 77, Rome (RM)

Edoardo D'Andrassi*

Department of Business Studies
Roma Tre University
Via Silvio D'Amico, 77, Rome (RM)

Francesca Ventimiglia

Department of business administration and marketing
Niccolò Cusano University
Via Don Carlo Gnocchi, 3, Rome (RM)

** Corresponding author*

Abstract

The purpose of the study is to analyze the credibility of non-financial reports of companies belonging to the fashion and luxury sector and to understand the role played by gender equity in the pursuit of sustainability goals.
The pursuit of sustainability by nations and companies is an increasingly discussed topic in the literature and is closely related to the ways in which the activities put in place are not only implemented, but also reported and disclosed.
In this context, sustainability issues are particularly relevant for companies operating in the fashion and luxury sector, where companies belonging to the "Made in Italy" can exploit a competitive advantage. In fact, a number of principles and regulations have emerged aimed at outlining proper reporting and disclosure of non-financial activities, among which those aimed at sustainability have assumed a prevalent role. Some companies, however, take a "check the box" approach with regard to sustainability-related reporting, and this has compromised their reputation, as positive results are extolled and negative ones omitted
Therefore, to achieve this goal, a qualitative content analysis of reports prepared in 2021 by No. 23 companies within the top 100 global luxury brands was conducted.
The qualitative analysis was carried out through a self-constructed credibility index based on Habermas' idealism. Credibility was considered as a construct consisting of: truthfulness, sincerity, and adequacy and comprehensibility. The results show that non-financial reports of companies operating in the fashion and luxury industries tend to have

low credibility. This result contributes to the expansion of empirical research directed at verifying the credibility of communications regarding the pursuit of sustainability goals carried out by companies.
The study also contributes to providing a better understanding on sustainability reporting carried out by companies in the luxury fashion industry by highlighting best practices that other companies can also follow.

Keywords – Gender studies, credibility index, CSR disclosure, Made in Italy, Sustainability

Paper type – Academic Research Paper

1 Introduction

The past decade has seen a significant increase in initiatives to promote responsible behavior, at the level of nations, businesses, and citizens. This process has also involved companies belonging to the luxury sector where customers are increasingly interested in how companies carry out production (Marshall et al., 2016).

In this context, many companies have activated sustainable programs throughout the value chain and, consequently, there has been an intense activity aimed at making timely disclosure regarding sustainable performance within the broader sphere of non-financial reporting (Jestratijevic et al., 2020).

The fashion and luxury industry has also been involved in such reporting practices and in the process aimed at pursuing sustainability (D'Anolfo et al., 2017; Kapferer and Michaut-Denizeau, 2014) as shown in a recent survey (McKinsey, 2022).

This has resulted in companies dedicating specific reports to related sustainability goals (Jestratijevic et al., 2022) and, as a result, several international reporting frameworks have developed over the years, of which the most relevant are the Global Reporting Initiative (GRI) and the International Integrated Reporting Council (IIRC) (Izzo et al., 2020). These frameworks are intended to guide companies in the selection of information to be included in reports.

Corporate reporting can also be influenced by the choices made by companies (Landrum & Ohsowski, 2018), and in this context, environmental and social governance (ESG) factors become a crucial element for stakeholders in assessing corporate performance (Savio et al., 2023).

Therefore, it seems crucial to understand what reporting policies are used by companies and, in particular, those belonging to the fashion industry by placing

special emphasis on the credibility of the information rendered to corporate stakeholders (Li et al., 2014).

In fact, the increase in the number of reports prepared by companies and the amount of information provided has raised questions about the credibility of such disclosure (Chen et al., 2014).

The study, therefore, aims to analyze the disclosure made by companies belonging to the luxury sector in order to understand the level of information conveyed to the market.

Specifically, the study intends to analyze: i) the credibility of the reports prepared by companies belonging to the fashion and luxury sector; ii) the role played by gender partisanship and in particular SDG 5 in the pursuit of sustainability; and iii) the role played by made in Italy in external corporate communication.

Credibility was conceptualized on the basis of Habermas' theory of communicative action (1984, 1987, 1990), which operationalizes it on the basis of three subdimensions: truthfulness, sincerity, appropriateness and comprehensibility.

To achieve the objective of the study, the 2021 sustainability reports of 23 companies belonging to the fashion and luxury industry were analyzed. The results obtained show low credibility of these reports.

The study, which is among the first to investigate the credibility of disclosures made by companies belonging to the fashion and luxury sector, makes contributions to both the literature and practice.

It contributes to the existing literature by providing empirical results on the issue of the credibility of reports made by companies. Second, the results of the study provide suggestions to companies on ways they can use to increase the credibility of their disclosures to stakeholders and, as a result, increase trust between companies and stakeholders.

2 Literature review

Reporting activities carried out by companies are gaining both academic and practical interest in all sectors, including the fashion and luxury industry, for which it has been argued that it possesses characteristics that make companies operating in it inherently sustainable (Garvare & Johansson, 2010).

In what follows, the theoretical background of the research will be outlined with reference to both corporate reporting and critical factors related to the sustainability of enterprises belonging to the fashion and luxury sector.

2.1 The implementation of sustainability corporate reporting

In light of the fact that society is increasing expectations of companies on disclosure beyond financial performance, voluntary disclosure continues to be a growing area of interest for companies (Stuart et al., 2022). In tandem, the accounting literature has also increased the number of studies dealing with corporate CSR disclosure. However, however, the growth of studies have been modest in the area of the quality of disclosure made (Huang & Watson, 2015) and even more so in the area related to the credibility of communications made by companies (Lock & Seele, 2016) for which a high potential for research has been indicated, as it has been recognized that non-financial reports by companies lack credibility (MacLean & Rebernak, 2007).

Since disclosures made by companies on sustainability issues are predominantly voluntary, the research initially analyzed what factors lead to the decision to disclose. The researchers then used different theories to carry out this analysis and found that companies may use disclosure on sustainability issues for self-interested purposes and to satisfy a variety of stakeholders (Stuart et al., 2022). This circumstance raises questions about the credibility of such disclosure (Chen et al., 2014).

The literature in an attempt to increase knowledge on the topic has therefore sought to fill this gap.

Indeed, academics and practitioners have developed some proxies for assessing the quality of CSR carried out by companies. The first measures developed focused on quantitative measures (Shane & Spicer, 1983; Bowman & Haire, 1976). Over time, researchers began to qualitatively analyze the content disclosed by companies (Wiseman, 1982; Luo & Wu, 2019) by first indicating which elements are inconsistent with high-quality non-financial disclosure. Indeed, some authors (Cho et al., 2012; Boiral, 2013) have found that CSR disclosure is often used to obfuscate companies' true performance on sustainability issues.

It therefore becomes crucial to focus not only on what elements can determine quality disclosure, but more importantly what elements can improve the credibility of companies' reports.

2.2 Sustainability in the luxury market

Recent years have seen a radical shift with reference to the sustainable approach of luxury brands (Joy et al., 2012), as companies in this sector realized that it could become a driver of success.

Indeed, companies belonging to the sector have incorporated sustainable actions into their business strategies (Kang & Sung, 2022) and have made specific disclosures to communicate to stakeholders their efforts to integrate sustainable practices (Arrigo, 2018).

Indeed, consumers with high purchasing power have begun to pay more attention to environmental and sustainability issues (Garcia-Torres et al., 2017). As a result, the concept of "sustainable luxury" has emerged and is gaining increasing relevance (Karaosman et al., 2020) and is developing in the literature in three distinct research strands: i) harms, supply chain and communication; ii) CSR issues; and iii) issues related to sustainable activities of luxury producers.

The literature, however, has also noted a possible contradiction between the typical values of luxury businesses that focus on exclusivity and hedonism and those, on the other hand, typical of sustainability aimed at equality and universalism (Torelli et al., 2012; Wong & Dhanesh, 2017).

It is from such possible contradictions that the analysis of how companies belonging to this sector communicate the pursuit of sustainability goals to strengthen their corporate identities becomes relevant (Balmer et al., 2011).

The literature that has focused on analyzing corporate social communication in the luxury and fashion industry has found that excessive communication in this regard can devalue the prestige of brands (Athwal et al., 2019; Janssen et al., 2017). This study-responding to requests for further investigation made by previous literature (Wells et al., 2021; Athwal et al., 2019)-therefore aims to fill an important gap in the literature, namely the empirical analysis of the credibility of sustainability communications of companies belonging to the luxury sector.

3 The research framework

In order to explore the credibility of reports from companies belonging to the luxury sector, consistent with the prevailing literature, a qualitative analysis of secondary data was conducted (Morhardt et al., 2002).

To this end, first, the scope of the research was determined and second, the framework of analysis.

3.1 Sample

In order to analyze the credibility of the sustainability reports of companies belonging to the luxury industry, it was first necessary to select the companies to be included in the sample. Consistent with the previous literature, the 2022 ranking of the Global Powers of Luxury Goods conducted by Deloitte (Deloitte, 2022) was analyzed. This document identifies the top 100 companies belonging to the luxury sector globally based on sales in the previous year.

The following criteria were used to define the sample under analysis starting with the companies belonging to the Deloitte ranking: i) companies operating mainly in the fashion field (thus, companies producing jewelry, watches or luggage were excluded); ii) availability of the 2021 sustainability report within the company websites.

The application of the described criteria led to the definition of a sample of No. 23 companies (Table 1). A preliminary observation of the sample shows that two continents, Europe and North America, are exclusively represented. Specifically, 19 European companies are included in the sample, with a predominance of Italian companies constituting 42 percent of the sample (No. 10 companies).

Table 1: The sample analyzed

Name of company	Country of origin	Zone	Selection of luxury brands	FY2021 Total revenue (US$M)
Acne Studios Holding AB	Sweden	Europe	Acne Studios	278
Aeffe SpA	Italy	Europe	Moschino, Pollini, Alberta Ferretti,	394
Aritzia Inc.	Canada	(North) America	Wilfred, Babaton, TNA	643
Brunello Cucinelli SpA	Italy	Europe	Brunello Cucinelli	854
Burberry Group plc	United Kingdom	Europe	Burberry	3060
Canada Goose Holdings Inc.	Canada	(North) America	Canada Goose, Baffin	683
Capri Holdings Limited	United Kingdom	Europe	Michael Kors, MICHAEL Michael Kors, Jimmy Choo, Versace	4060
Ermenegildo Zegna N.V.	Italy	Europe	Zegna, THOM BROWNE	1538
Giorgio Armani SpA	Italy	Europe	Giorgio Armani, Emporio Armani, A|X Armani Exchange	2398
Golden Goose SpA	Italy	Europe	Golden Goose	456
Hermès International SCA	France	Europe	Hermès, John Lobb	10619

Kering SA	France	Europe	Gucci, Saint Laurent, Bottega Veneta, Balenciaga, Alexander McQueen, Brioni, Boucheron, Qeelin	20861
LVMH Moët Hennessy-Louis Vuitton SE	France	Europe	Louis Vuitton, Christian Dior, Fendi, Tiffany & Co., Bvlgari, Loro Piana, Emilio Pucci, Off-White, Acqua di Parma, Loewe, Marc Jacobs, TAG Heuer, Benefit Cosmetics	75920
Marc O'Polo AG	Germany	Europe	MARC O'POLO	463
Moncler SpA	Italy	Europe	Moncler, Stone Island	2419
OTB SpA	Italy	Europe	Diesel, Maison Margiela, Marni, Viktor&Rolf, Jil Sander	1963
Prada Group	Italy	Europe	Prada, Miu Miu, Church's, Car Shoe	3979
PVH Corp.	United States	(North) America	Calvin Klein, Tommy Hilfiger	7133
Ralph Lauren Corporation	United States	(North) America	Ralph Lauren, Polo Ralph Lauren, Lauren Ralph Lauren	4401
Salvatore Ferragamo SpA	Italy	Europe	Salvatore Ferragamo	1342
Tapestry, Inc.	United States	(North) America	Coach, Kate Spade, Stuart Weitzman	5746
TFG Brands (London) Limited	United Kingdom	Europe	Hobbs, Whistles, Phase Eight	256
TOD'S SpA	Italy	Europe	Tod's, Roger Vivier, Hogan, Fay	1064

3.2 The Research Framework

To analyze the credibility of sustainability reports of companies belonging to the luxury sector, the authors referred to the framework used by Mazzotta et al. (2020), who based on the theory of material legitimacy as defined by Dumay et al. (2015) and Habermas' (1984) theory of communicative action, identified what requirements make rational communication possible. These requirements are truthfulness, sincerity, intelligibility, and appropriateness and were declined based on the findings of previous literature as represented in Table 2.

Table 2: The framework

DIMENSION	SUB-DIMENSION	ITEM	MEASURE	RATING	REFERENCES
Truth	Assurance	Type of assurance	Accountant, non-accountant	0/1	Lock & Seele, 2016; Simnett et al., 2009; Reynolds & Youthas, 2008;
		Extent of assurance	Entire report, specific section/not specified	0/1	
		Level of Assurance	Limited, reasonable	0/1	
	Report's features	Standard application level	GRI referenced: in accordance (core), in accordance (comprehensive)	0/2	Lock & Seele, 2016
		Lenght of the report	Normalized lenght	0/1	Beretta & Bozzolan, 2008; Gray et al., 1995;
		Location of the report	Annual report/integrated report, autonomous document	0/1	Mazzotta, 2020
	Accuracy	Methodology	Section on methodology (yes/no)	0/1	Reynolds & Youthas, 2008
		Data measurement	Info on data measurement (yes/no)	0/1	
Sincerity	Materiality	Materiality matrix	Existence of a materiality matrix, updating of the materiality matrix, ratifying of the materiality matrix by the Board of Directors	0/1	Amelio et al., 2018; Michelon et al., 2015; Hahn & Kühnen, 2013;
	Stakeholders' relationship	Stakeholder mapping	Stakeholder description (yes/no)	0/1	Searcy & Buslovich, 2014
		Stakeholder dialogue	Section on stakeholder dialogue (yes/no)	0/1	
		Stakeholder engagement	Section on stakeholder engagement (yes/no) 0/1	0/1	

	Sustainability governance	Sustainability committee	yes/not (if yes, autonomous or inside an existing committee)	0/2	Amelio et al., 2018
	Sustainable Development Goals	Reference to SDGs	yes/not (if yes, autonomous or inside an existing committee)	0/1	Izzo et al., 2020; Amelio et al., 2018
Appropriateness and understandability	Readability		Normalized Gulp index	0/1	Reynolds & Youthas, 2008
	Communication		The use of visual tools	0/1	Helfaya et al., 2019

Therefore, having defined the sample the data were extracted from the company documents available on the websites of the sample constituent companies (Hahn and Leulfs, 2014; Dilling, 2010). Once the company reports were downloaded, the authors performed a content analysis (Krippendorff, 2004) that was conducted manually by the authors.

To improve the reliability and replicability of the analyses performed, the authors firstly defined the research framework punctually (Duriau et al., 2007). All documents from the sample firms were examined on the basis of a framework in which a value of 1 was assigned in case the element under investigation was detected and 0 otherwise (Hahn and Leulfs, 2014).

In addition, the authors used inter-coder reliability, which ensures the reliability of the classification procedure (Savio et al., 2023). This model considers the classification valid only if the result arrived at is the same for different coders (Weber, 1990).

The first of the variables analyzed is the truth dimension for which the literature has indicated that it has a positive impact on the credibility of communications made by companies (Simnett et al, 2009). The truth dimension has been divided into type, extent, and level of assurance (Lock & Seele, 2016; Reynolds & Youthas, 2008).

The second dimension of credibility, truthfulness, has been divided into four sub-dimensions: materiality, stakeholder relations, sustainability governance committee, and Sustainable Development Goals (SDGs).

The last dimension of credibility, composed of adequacy and understandability, was broken down into readability and communication.

The sum of the dimensions of the credibility construct return the credibility index, a semi-objective index that can take a value between 0 and 20.

4 Results, discussions, and conclusions

The study analyzes sustainability communications made by companies belonging to the fashion and luxury industry in reports published on their respective websites. The analysis was aimed at checking the credibility of such communications.

To achieve the research objective, the authors conducted a content analysis of the reports prepared by the companies in the sample. In particular, a research framework derived from Habermas' theory of communicative action was used, consistent with previous studies. The determined framework of analysis allowed the determination of a semi-objective credibility index that considers the dimensions of truthfulness, sincerity and comprehensibility. These dimensions were in turn subdivided into sub-dimensions and, subsequently, into items. The subdivision made was based on literature that identified communication items that have a positive association with credibility.

The study, to the best of the authors' knowledge, was the first to analyze the credibility of companies belonging to the fashion and luxury industry for which sustainability issues play a strategic role.

The results, shown in Image 1, highlight that the disclosures made by companies belonging to the luxury sector tend to be truthful, but not very credible, with most of the companies being in the medium to low sincerity range of the credibility matrix. This result is believed to be inconsistent with the maturity of the companies in the sample in disclosing social issues and with the results of studies investigating the quality of non-financial information (Lock & Seele, 2016). The results show that companies belonging to luxury and fashion did not pay much attention to strengthening confidence in the credibility of their NFIs. Moreover, the use in some cases of standards such as GRI, recalled by 60 percent of the companies in the sample, can only be done to check a compliance box and not to change the activities performed and/or the impact on the environment (La Torre et al., 2018).

In addition, the analysis of the SDGs showed that less than half of the companies in the sample reported gender equality as one of the goals pursued, for which the literature has shown that it represents the goal that should be prioritized in the expected pursuit that allows for improved performance even in the high SDGs (Dello Strologo et al., 2022; 2023).

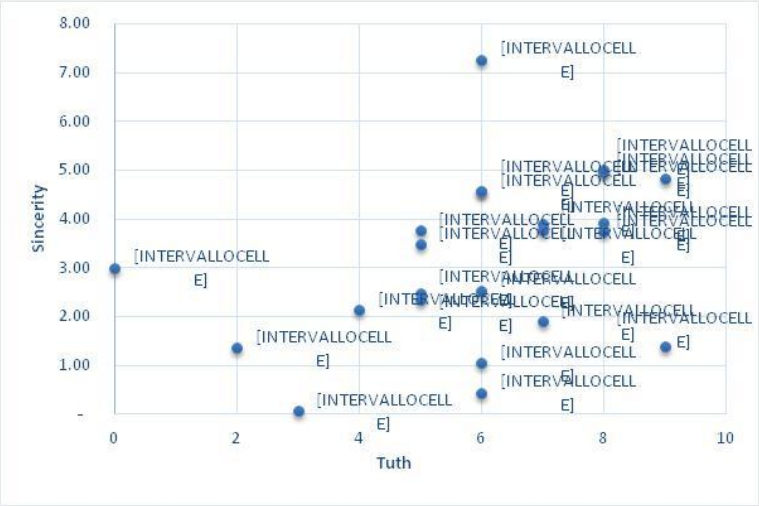

Image 1: The results

Despite the relevance of the results obtained through the present study, it is believed that this study is not without its limitations. First, the study analyzes reports from only No. 23 enterprises belonging to the fashion and luxury sector, and therefore, the results achieved may not be generalized to other enterprises. Future research could therefore expand the sample both to include more enterprises belonging to the same sector and to analyze different sectors. A second limitation of the study is that it focused on only one year, 2021, but that takes into account problems arising from Covid-19.

A possible future line of research could therefore carry out the analysis over a longer period of time in order to also compare the performance of the credibility index over time.

Despite the limitations, it is believed that the study may have both implications for the literature and for managers. The results highlight that companies operating in the fashion and luxury industries should seek to make their sustainability communications credible by increasing their levels of truth and sincerity.

At the managerial level, the results make it possible to highlight the parameters for improving the sincerity of communications related to sustainability actions carried out by companies and to draw the line to follow in writing and reading/understanding non-financial communications issued by companies.

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Gender Bond, Innovative Financial Tools in Woman Enterprises

Niccolò Paoloni

Roma Tre University
Via Ostiense, 161/165 - 00145 Rome

Giuseppe Modaffari

La Sapienza University of Rome
Via del Castro Laurenziano, 9 - 00161 Rome (IT)

Martina Manzo*

Roma Tre University
Via Silvio D'Amico, 77 – 00145 Rome (IT)

* *Corresponding author*

Abstract

This paper aims to analyse how an innovative financial tool for female-led Small and Medium-sized Enterprises (SMEs) can contribute to the development and sustainability of these businesses. Women's enterprises can only reach high levels of indebtedness if there are equally high personal guarantees. Women's enterprises have always been distinguished from men's enterprises by simpler financial management, mainly related to the control of internal sources of finance, such as treasury and equity of the female entrepreneur, and only residually of external sources by way of debt capital. The development of sustainable finance in recent years has opened up the use of capital to the explicit aim of reducing the gender gap. In this context, Gender Bonds (GB) seem to be the most viable solution to solve this issue and, at the same time, meet today's sustainable development challenge. In this way, the present paper aims to answer the following RQ.
RQ1: what is a Gender Bond and what are its characteristics in term of sustainability?
RQ2: what economic and financial benefits can a GB bring to women's enterprises?
The present work is supported by an exploratory descriptive qualitative (EDQ) research. As above, EDQ conducted by document analysis represents the first step in developing grounded theory (GT).
This paper aims to expand the literature on the topic of sustainable financial tools for woman enterprises, with a special focus on the gender bond. This study therefore highlights how all those new financial tools, such as gender bond, succeed in improving the economic results of woman companies. It also highlights how the use of gender bond can allow to woman enterprises to improve their financial structure.

Keywords – gender bond, sustainability, innovative finance, gender, SME

Nature of proposed paper - Academic Research Paper

1 Introduction

Recent studies have shown a positive correlation between global economic development and the presence of women entrepreneurs (Mustapha, 2016; Ramadani et al., 2015; Sowmya et al., 2010). Despite progress in integrating women into the workforce, they still face significant challenges in maintaining a work-life balance. Previous studies have shown that women experience social, cultural, and economic discrimination, which has resulted in an entrepreneurial gender gap (Dal Mas and Paoloni, 2019). This gap is characterised by a low number of female-led enterprises and structural limitations that affect their competitiveness. The root cause of this gap is often attributed to an educational gap that impacts women's entrepreneurial intentions and performance (Modaffari and Manzo, 2022; Paoloni, 2021). Although gender inequality is gradually decreasing, in many countries, even among the seemingly more developed ones, there are still many difficulties for women and, in general, there is a pervasive and stubborn mentality that pays little attention to the issue (United Nations, 2021) that does not allow SDG 5 to progress appreciably and, logically, to meet the deadlines dictated by the Plan in the scarce decade that remains (Thil et al., 2021). In finance, these issues are also beginning to be the subject of interest by investors, as it pays to finance actions to eliminate the gender gap or, at least, to manage it.

The development of sustainable finance in recent years has opened up the use of capital to the explicit aim of reducing the gender gap. In this context, Gender Bonds (GB) seem to be the most viable solution to solve this issue and, at the same time, meet today's sustainable development challenge. In this way, the present paper aims to answer the following RQ.

RQ1: what is a Gender Bond and what are its characteristics in term of sustainability?

RQ2: what economic and financial benefits can a GB bring to women's enterprises?

The present work is supported by an exploratory descriptive qualitative (EDQ) research. Exploratory research can be defined in several ways, but from a

comprehensive perspective it consists of an attempt to explore something new and interesting, by working your way through a research topic. o reach the declared goal, in the present paper EDQ methodology has been conducted by the document analysis (Bowen, 2009). This method concerns to a systematic procedure for reviewing or evaluating documents, allowing researchers to develop empirical knowledge on the topic analysed (Corbin and Strauss, 2008; Rapley, 2007).

From the document analysed emerges that the Gender Bond is a type of bond whose objective is to support entrepreneurial companies managed by women in order to reduce the Gender Pay Gap and to search for new financial sources to support women's business. Aiming at achieving gender equality and women's empowerment through financing projects and economic activities, gender bonds encourage behaviour and corporate policies in line with Goal 5 of the SDGs. They can be used to improve gender equality in many areas of the entreprises like in terms of representation of women in leader roles or among the employees and the benefits can be measured through some performance KPI exposed in the Appendix of the present paper (table 1).

This paper aims to expand the literature on the topic of sustainable financial tools for woman enterprises, with a special focus on the gender bond.

2 Literature review

Over time, women's participation increasing in the workforce has led to a growing interest in studying the subject and developing models for these businesses (Paoloni et al., 2021). Since the late 1990s, in Europe and Italy, women-led businesses have been recognised as a key factor in improving the economy, employment, and society.

Recent studies have shown a positive correlation between global economic development and the presence of women entrepreneurs (Mustapha, 2016; Ramadani et al., 2015; Sowmya et al., 2010).

Specifically, the participation of women in economic activities, especially in developing countries, would help to produce employment, welfare and health, reduce poverty, create human resource development and increase the level of education (Neumeyer et al., 2019; Brush and Cooper, 2012). Recent OECD studies, nevertheless, show that if by 2040 female labour participation, especially in the entrepreneurial capacity, were to reach male levels, the Italian labour force would

grow by 7%, and GDP per capita would increase by 1 percentage point per year. In this sense, sustainable finance may represent an interesting challenge.

Despite progress in integrating women into the workforce, they still face significant challenges in maintaining a work-life balance. Previous studies have shown that women experience social, cultural, and economic discrimination, which has resulted in an entrepreneurial gender gap (Dal Mas and Paoloni, 2019). This gap is characterised by a low number of female-led enterprises and structural limitations that affect their competitiveness. The root cause of this gap is often attributed to an educational gap that impacts women's entrepreneurial intentions and performance (Modaffari and Manzo, 2022; Paoloni, 2021).

These have been attributed to differences in human and social capital (Greene, 2000); differences in the degree of risk tolerated and endured (Jianakoplos and Bernasek, 1998); differences in managerial style (Brush, 1992); and the greater sensitivity of women than men in considering all the factors involved, financial and otherwise. Among the typical characteristics of the female personality, we note, first and foremost, risk aversion, which leads women to invest in projects with low-risk profiles and to manage businesses with low rates of debt (Langowitz and Minniti, 2007). This is attributed to their fear of bankruptcy (Carter and Cannon, 1992) and the relative fear arising from the social embarrassment that would eventually result from the failure of their business (Shabbir and Di Gregorio, 1996).

Another factor to consider is the lower negotiating propensity (Amanatullah and Morris, 2010). It has been noted that, in the negotiation stages, women are less inclined to bargain than men, especially to defend their causes and substantiate their arguments. Lastly, women need more self-confidence in the economic-financial sphere and are disinclined to seek start-up capital from credit institutions if they are more likely to use credit granted to them by family and friends (Modaffari and Manzo, 2022). Furthermore, the fact that women generally seek greater flexibility to prioritise home production leads them to move towards industries where entry and capital costs are low and where work-life balance is easily achievable. For this reason, they are mainly concentrated in the service sector, particularly those dedicated to personal care, health and social care, education, retail, catering and clothing.

These elements reinforce investors' propensity to finance business activities that are more profitable and for which the economic returns are higher and less risky, thus more frequently those of men (Brooks et al., 2014).

For all these reasons, female entrepreneurs often struggle to access credit, which threatens their competitiveness (Aernoudt and De San José, 2020; Cotei and Farhat, 2017; Derera et al., 2014). To address these challenges, entrepreneurs can adopt different strategic choices, such as seeking alternative financial sources and microfinance institutions or relying more on family loans (Yazdanfar and Abbasian, 2013).

According to several studies, when women, in the early stage of their business, request venture capital, they receive significantly less funding than their male counterparts, which, in line with international research findings (Roper and Scott, 2009; Fielden et al., 2003), indicate a strong behavioural bias of banks against the former. Suffice it to note that the credit openness towards women, in the case of microcredit, is reversed compared to the traditional trend: according to the Microfinance Barometer report (2019), women, globally, are the predominant beneficiaries of microfinance institutions, accounting for about 80% of microloans.

According to data from the Policy Brief on Women's Entrepreneurship, prepared for the Organisation for Economic Co-operation and Development (OECD), at the European level, on average, men are able to access the financial resources they need to start their own businesses 1.5 times more than women; while, at the national level, this figure is still rising, at 2.3 (Halabisky, 2018)

In Italy, only 29% of female entrepreneurs state that they have no problems in dealing with credit institutions; on the contrary, the remaining part openly states that they encounter the greatest problems with (i.) the conditions of the economic and social context; (ii.) the high guarantees required, regardless of the goodness of the project being assessed and (iii.) discouragement for fear of being rejected. Thus, it follows that the gender variable intersects with others linked to the peculiarities of female feelings and the characteristics of the enterprise and its size (Alesina et al., 2013; Saparito et al., 2013).

However, the problems inherent to women's enterprises and credit institutions must be read according to the broader and more critical meaning of a change in the traditional and pre-existing relationship of esteem between the customer and the bank. With the process of economic globalisation and the opening of financial markets to international competitors, however, the balance of the banking system has been altered.

To support the real economy, banks no longer limit themselves to granting credit and managing customers' assets but structure efficient strategies to foster

the economic growth of the countries where they are located, working alongside companies - the founding fabric of the production system - to support them in the modern markets of the leading sectors and in the most innovative businesses.

This new function reflects the needs of an economic system willing to interact with the surrounding environment that, through open and increasingly digitised platforms, allows constant innovation to satisfy even the most demanding customers.

The functioning of the economic system depends as much on the natural ecosystem as it does on aspects of social equity, such as the distribution of wealth, respect for human rights and freedoms, gender inclusion in economic activities and corporate responsibility (Kobayashi and Fukushima, 2012), which manifest themselves in different forms and degrees according to the territory they belong to and the actors who promote them.

Although gender inequality is gradually decreasing, in many countries, even among the seemingly more developed ones, there are still many difficulties for women and, in general, there is a pervasive and stubborn mentality that pays little attention to the issue (United Nations, 2021) that does not allow SDG 5 to progress appreciably and, logically, to meet the deadlines dictated by the Plan in the scarce decade that remains (Thil et al., 2021).

In relation to the national context, it was observed that, at the end of 2019, the female employment rate had only reached 50 per cent, well below the European average rate (around 63 per cent).

The development of sustainable finance in recent years has opened up the use of capital to the explicit aim of reducing the gender gap. Sustainable finance is about a joined-up approach to the development of financial services that integrate the ESG dimensions across market practices, products and policy frameworks' (Alessi et al., 2022). It represents the set of business strategies and investment choices that, in identifying assets to be promoted, considers ESG aspects according to a holistic approach (Recalcati and Carulli, 2021).

In particular, the advent of sustainable finance in recent years has opened up new avenues for the use of capital, which, among other social issues, include the explicit narrowing of the gender gap.

Given the growing demand for financial instruments that incorporate gender-based factors, such as women's influence and employment, a variety of financial products are now emerging, including bonds, exchange-traded notes (ETNs) and exchange-traded funds (ETFs), certificates of deposit and private equity funds, all

focused on achieving gender equality. In this context Gender Bonds seem to be the most viable solution to solve this issue and, at the same time, meet today's sustainable development. However, to explain in what terms this is true, it is necessary to look at the institutional efforts made in the past to strengthen decision-making independence and stimulate the employment autonomy of women and girls. Gender bonds, on the other hand, could more effectively counteract the unequal treatment experienced by women in the world of work while still offering, to those who intentionally invest in them, a definite commercial advantage commensurate with the natural economic return.

3 Design/methodology approach:

Exploratory Descriptive Qualitative (EDQ) research (Carvalho et al., 2005; Cleff, 2014; Modaffari and della Corte, 2022) supports the paper. EDQ is a qualitative methodology suitable for addressing research objectives that aim to provide a direct description of phenomena (Sandelowski, 2004). Particularly, Caelli et al., 2003 points out that this methodology allows scholars to learn about the involved subjects, their characteristics and the locations of the phenomenon of interest.

Exploratory research can be defined in several ways, but from a comprehensive perspective it consists of an attempt to explore something new and interesting, by working your way through a research topic (Swedberg, 2020). Explorative research can be defined as a method aimed at underlining how a phenomenon is manifested. Explorative research allows researchers to explore an issue with limited coverage, contributing to the development of new knowledge in that area (Glaser and Strauss, 1967; Glaser, 1978). According to Hunter et al. (2019), EDQ methodology was born as a hybrid methodology between the exploratory research proposed by Stebbins (2001) and the descriptive qualitative research promoted by Sandelowski (2004; 2010). Specifically, Stebbins (2001), defines explorative research as the conception of an exploratory project to be developed through research design, data collection, and final report writing.

Sandelowski (2010) emphasizes that qualitative descriptive studies are not intended to rescue poorly or partially conducted research. Rather, they are appropriate when a different, more interpretive qualitative methodology would not have been better suited to the research goals.

To reach the declared goal, in the present paper EDQ methodology has been conducted by the document analysis (Bowen, 2009). This method concerns to a

systematic procedure for reviewing or evaluating documents, allowing researchers to develop empirical knowledge on the topic analysed (Corbin and Strauss, 2008; Rapley, 2007). As above, EDQ conducted by document analysis represents the first step in developing grounded theory (GT) (Glaser and Strauss, 1967; Corbin and Strauss, 1998). According to Glaser and Strauss, 1967 recalling the attention to the usefulness of documents for theory building, pari passu document analysis represents the first explanatory step to build a theory on the phenomenon of gender bond and its usefulness in supporting small medium enterprises (SMEs) led by women.

Assuming document analysis as a technique to conduct intensive studies of a single phenomenon, event, organisation, or program (Stake, 1995; Yin, 1994), one of its main goals can be recognized in verifying findings and corroborate evidences from other sources. Therefore, to reach this goal become fundamental the triangulate process between the information. The triangulation allows the researchers to validate the data sources obtained during the study (Angers and Machtmes, 2005; Bowen, 2003).

Regarding the gender bond issue, no relevant literature has been produced by scholars, in fact, advancing a query by keywords on Scopus database at 2023, Apr 04, a solo contribution emerged.

In this way, the authors enrich their data sources by the following authoritative sources, points out by international practitioners and public entities (de la Roza and Romero, 2023; CDP, 2021; IFC, 2021; IISD, 2021; FSD Africa, 2020).

4 Findings and Discussion

The documents analysed in this paper are institutional documents aimed at defining the gender bond framework in different parts of the world. The information elicited allowed us to answer our two research questions.

From the combined analysis, gender bonds can be traced back to thematic bonds, i.e. bonds whose issuance is aimed at achieving a sustainable purpose and to which Green Bonds, Social Bonds and Sustainability Bonds also belong (IFC, 2021).

There are two approaches to issuing Gender Bonds: i) the use-of-proceeds approach, which requires issuers to use all proceeds of the bond issue to implement the types of projects identified prior to the bond issue; ii) and the performance-based approach, which incorporates quantifiable key performance

indicators to assess and compare impacts, as well as to evaluate improvements in its sustainability performance targets, by a given date (de la Roza and Romero, 2023). Proceeds from the issuance of these different types of bonds must be used to finance or refinance, in whole or in part, new and/or existing Eligible Loans/Projects that fall within the Eligible Categories and meet the Eligibility Criteria (CDP, 2021). Eligible Categories include infrastructure and city development; SMEs and corporate finance; social housing; green energy and environmental sustainability. As to the way the funds are raised, as explained in the document IFC (2021) in Gender Bonds, the cash flows needed by the underwriter to repay the debt granted to it may come (i.) directly from the gender-oriented activities or projects identified for the bond issue or (ii.) from its other business activities, not necessarily linked to the support of women's empowerment. These two different mechanisms correspond to the type of approach adopted for issuing the instrument itself, i.e. the use-of-proceeds approach or the performance-based approach. In the first case, the proceeds of the bond are used to finance activities that have a direct impact on the livelihood and welfare of the female gender, one example being the provision of credit to small and medium-sized enterprises run by women; in the second case, instead, the proceeds obtained constitute a reward for the issuer for the adoption of internal policies rather than for the achievement of performance that benefits women, such as the inclusion of more women on its board.

IFC (2021) defines a framework of corporate areas where gender equality can be pursued through funds raised through gender bonds. For instance, in the area of corporate leadership, gender bonds can be used for the activation of mentoring programmes to strengthen the pipeline of female talent for board and management positions; in the area of workforce representation, they can be used to build awareness and reduce bias, or to implement respectful workplace programs to assess, prevent, and address gender-based violence above and beyond required risk mitigation programs. They can further be used to develop and offer products and services that will disproportionately benefit women, like digital products, childcare facilities, and mobility services, or to build facilities that provide services primarily for women. Concerning the customer experience, they can help upgrade facilities or improve services to increase safety or access for women, including women with disabilities, or to train staff to address unconscious bias and better serve women customers/users' distinct use patterns, needs, and preferences. Gender bond che help offer skill-building, digital literacy, business

development training, and other support that targets or is tailored to the needs of women in the community. Hence, to reply RQ1(*what is a gender bond and what are its characteristics in term of sustainability?*), the Gender Bond is a type of bond whose objective is to support entrepreneurial companies managed by women in order to reduce the Gender Pay Gap and to search for new financial sources to support women's business. Aiming at achieving gender equality and women's empowerment through financing projects and economic activities, gender bonds encourage behaviour and corporate policies in line with Goal 5 of the SDGs. The results have started to point out that the greatest obstacle encountered by women in starting their own businesses and growing them over time has always resided in the difficulty of accessing credit (Brush et al., 2014), mainly due to (i.) a strong tendency to attend marginal and less profitable sectors; (ii.) lower experiential levels and (iii.) less reliable credit scores in the lending process (Alesina et al., 2013; Saparito et al., 2013).

For these reasons, the approach adopted at the institutional level in recent decades has led government bodies to provide more resources to women, in particular by creating the preconditions for easier access to finance and wider knowledge networks as well as by providing training, coaching and mentoring to enrich their entrepreneurial spirit.

RQ2: what economic and financial benefits can a gender bond bring to women's enterprises?

IFC (2021) defines a framework of corporate areas in which gender equality can be pursued through funds raised through gender bonds. For instance, in the area of corporate leadership, gender bonds can be used to activate mentoring programs to strengthen the pipeline of female talent for board and management positions; in the context of representation in the workforce, they can be used to build awareness and reduce bias, or to implement respectful workplace programs to assess, prevent, and address gender-based violence above and beyond required risk mitigation programs. They can further be used to develop and offer products and services that will disproportionately benefit women, like digital products, childcare facilities, and mobility services, or to build facilities that provide services primarily for women. Concerning the customer experience, they can help upgrade facilities or improve services to increase safety or access for women, including women with disabilities, or train staff to address unconscious bias and better serve women customers/users' distinct use patterns, needs, and preferences. Gender bonds can help offer skill-building, digital literacy, business

development training, and other support that targets or is tailored to the needs of women in the community. Most important, the framework also define some KPI allowing to identify and measure the economic and financial benefits that women's enterprise can obtain. They are shown in the table 1 in the Appendix.

5 Conclusion

As already outlined, the biggest obstacle encountered by these to start their own business and grow it over time has always been the difficulty in accessing credit (Brush et al., 2014), mainly due to (i.) a solid tendency to attend marginal and less profitable sectors; (ii.) lower experiential levels and (iii.) less reliable credit scores in the lending process (Alesina et al., 2013; Saparito et al., 2013). It turns out that companies with greater gender parity, particularly at higher hierarchical levels, are better managed, more innovative and less inclined to take high risks than companies whose shareholders are predominantly male.

Gender equality is a much-debated topic these days thanks, above all, to the growing activism that has brought much attention to the issues of the Gender Gap and Gender Equality. In finance, these issues are also beginning to be the subject of interest by investors, as it pays to finance actions to eliminate the gender gap or, at least, to manage it.

For years, attempts have been made to solve the problem of access to credit for women's businesses, which are victims of discrimination and limitations by the banks themselves. However, precisely because, as analysed for women's enterprises, bank credit is a difficult instrument to exploit due to the historical vicissitudes that have involved the banking system and due to the lack of trust in these types of enterprises, alternative finance seems to be the optimal solution to the problem and, in particular, Gender Bonds can represent a valid support to the financial function of women's enterprises.

Gender Bonds aim to achieve gender equality and women's empowerment through financing projects and economic activities, encouraging behaviour and corporate policies in line with Goal 5 of the SDGs. Therefore, capital will be allocated based on predictions of the impacts that particular entities will have on women and the internal policies of various institutions regarding gender equality. According to IFC (2021) the gender-related projects that best lend themselves to using bond proceeds are specific training initiatives or funds for customised products and services and improving infrastructure to accommodate women

better. Opportunities to address gender inequalities vary depending on the type of issuer (public or private) and the sector and country of the issuer. Unfortunately, in Italy, issues of Gender Bonds have not yet taken place, and in the rest of the world, issues are scarce compared to the issuance of other types of thematic bonds. This shows how the topic of gender equality, despite being highly topical, has not yet wholly entered investors' minds, as most banks do not consider women-led SMEs as a segment requiring specific programmes and differentiated approaches.

The challenge is to make people understand how these bonds can be of great help for the growth and development of women's businesses and that, beyond government funds and aid provided by the state, a specific instrument to support female entrepreneurship can make a difference in terms of access to credit for women. The benefits deriving from this instrument can be countless, from eliminating the discrimination and limitations that women have faced up to now to enabling them to make investments without sacrificing financial returns, thus facilitating the mobilisation of private investment for sustainable development projects.

This paper aims to expand the literature on sustainable financial tools for women enterprises, focusing on the gender bond. This study, therefore, highlights how all those new financial tools, such as gender bonds, succeed in improving the economic results of woman companies. Furthermore, the analysis of the documents allowed us to study the gender bond phenomenon more closely and to answer our research questions, which constitute a starting point for a more in-depth future analysis aimed at studying more precisely the instrument's characteristics and its effects concerning a specific case study.

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Appendix

Table 1- Illustrative Key Performance Indicators

Leadership- Representation and Remuneration	• Number or percentage of women across all levels of leadership in the enterprise or in specific leadership roles with low representation • Retention rate for women leaders • Size of the gender pay gap among leadership • Percentage of women in leadership, sponsorship, and mentoring programs
Employees- Representation and Remuneration	• Number or percentage of women in the workforce or in specific areas with low • representation and among new hires and promotions • Retention rate for women in the workforce • Size of the gender pay gap • Percentage of women employees in training and development programs
Employees- Safe, Supportive and	• Availability of family-friendly policies/benefits and childcare for all employees • Active corporate certification related to gender equity in the workplace

Respectful Workplace	• Availability of policies and processes that prevent and address gender-based violence • for all employees
Supply Chain- Representation and Participation	• Number or percentage of women-owned or led or gender-responsive suppliers, distributors, or retailers in the value chain • Volume of procurement purchases from women-owned or led or gender-responsive suppliers (percent of the total) • Number of women-owned or led or gender-responsive businesses pre-qualified for future tenders • Volume of sales from women-owned or led or gender-responsive distributors, retailers, or agents (percent of the total)
Supply Chain- Skills Building and Support	• Number of women entrepreneurs or women in the value chain who have been provided with training • Number or percentage of suppliers, distributors, or retailers implementing livelihood/business skills training, mentoring programs, and so on, for women
Employees- Policies and Standards	• Percentage or number of businesses in the supply chain (suppliers, distributors, and/or retailers) that conduct gender assessments • Percentage or number of businesses in the supply chain that have adopted standards for gender responsive companies (for example, by signing the UN WEPs) • Percentage or number of businesses in the supply chain that have implemented gender equity codes of conduct or gender policies
Products and services- Representation in Customer/User Base	• Number or percentage of customers or users of products with a positive social impact that are women • Number or percentage of women-owned small and medium enterprises (SMEs) in the loan portfolio
Products and services- Targeted Offerings	• Number or percentage of product and/or service offerings designed, developed, or produced that will disproportionately benefit women • Number or percentage of products and/or services tailored to better meet the needs of women or increase access for women • Dollar amount or percentage of the portfolio or sales from products tailored to address the needs of women customers • Percentage, number, or dollar amount
Products and services- Customer/User Experience	• Number of facilities that provide services targeting women (for example, women's health clinics) • Number of facilities upgraded to increase safety or access for women • Number or percentage of staff trained to address unconscious bias and better serve women customers' distinct needs
Community- Representation	• Percentage of women participating in community assessments and stakeholder consultations • Percentage of women participating in community support programs
Community- Skills Building and Support	• Number of girls or women in the community empowered, trained, or supported • Number of community income generating programs led by women or number of women participants

Source- IFC, 2021

Starting from the Past Knowledge to Manage a Sustainable Present in a Continuum Design: A Best Practice from the City of Bacoli in the Phlegrean Fields

Marina Fumo*

Università degli Studi di Napoli Federico II
Piazzale V. Tecchio 80, Napoli (NA)

Marianna Illiano

Comune di Bacoli
Via Agrippina 32, Bacoli (NA)

Mariateresa Gamba

Università degli Studi di Napoli Federico II
Via Panoramica III traversa n.4, Monte di Procida (NA)

* *Corresponding author*

Abstract

The cultural landscape of Phlegrean Fields is famous for the variety and value of territory - volcanic and geo-morphological nature, archaeological and historical heritage, naturalistic and high biodiversity, rural areas- that forms the articulation of mutual relations as unique landscape of exceptional value and identity. This landscape has been in continuous evolution over the millennia for different reasons: 1) changes produced by volcanic activity and anthropic impact that it generates; 2) historical processes of settlement, from the Greek and Roman until the periods of depopulation after the fall of the Roman Empire, the reclamation of ninetieth and the industrial settlements of the twentieth century and finally the post II World War urban expansions and deindustrialization; 3) the socio-economic changes interacting with settlement. In this context, the identity of the city of Bacoli territory has acquired a progressive complexity and continuity, despite the current presence of critical elements, its matrix based on the permanence and interweaving of environmental and cultural values remains very strong. Starting from these strengths, the local government works on the KM by minimal sustainable projects that represent important actions to increase the community wellness. Also for the abandoned area of an ex-military site is proposed a green regeneration and reuse.

Keywords – Cultural Landscape, Sustainability, Knowledge management, Best practice

1 Introduction

The Phlegrean Fields represent one of the regional territories with the highest environmental and historical-archaeological value. The extraordinary volcanic nature of the places has caused the formation of important values: the particular scenic and natural beauty; thermal waters of excellent quality; brackish lakes and lagoons; protected inlets, real natural harbours; the copious presence of tuff and pozzolana, excellent building materials; a fishy sea; a fertile countryside whose most valuable production is represented by the heritage of original vines, unique in the world. These values determined, in the 1950s, the decision to bind for landscape protection purposes the entire territory of the municipalities of Bacoli, Monte di Procida and Pozzuoli. At the institutional level, it is no coincidence that a process of defining protective measures has been underway for some time: from the ministerial decrees that have declared several areas of the Phlegrean territory to be of considerable public interest under Law 1497/39, to the decrees issued under Law 1089/39 for historical and archaeological assets, to the approval of the current territorial landscape plan. Nowhere more than in the Phlegraean Fields is it essential to read the territory in terms of an ecological network, understood as a model of land planning and management based on the enhancement of endogenous resources. In fact, in this territory the mixture of natural resources, their use over the centuries, historical-cultural heritage and myth is inseparable. It is in this perspective that the municipal interventions for the enhancement of the territory and the case study are placed, which is intended to be a punctual recovery project to extensively enhance the Phlegrean cultural landscape with the definition of eco-museum routes for the defence and knowledge of the territory's identity.



Figure 14- The volcanic character of Phlegrean Fields

2 From the past to the sustainable development of the city of Bacoli

The territory of the city of Bacoli, the second largest in the Phlegrean peninsula, is located, together with that of the municipality of Monte di Procida, in the extreme southwest of the province of Naples. It has a polycentric territorial structure, consisting of five hamlets: Bacoli centre, Baia, Fusaro-Cuma, Cappella, Torregaveta and Miseno and Miliscola. The town stands on ancient *Bauli*, which was a renowned resort in Roman times almost as much as nearby *Baiae*, compared to which it offered greater quiet. Remains of considerable value can still be admired from that period, perfectly preserved in a unique setting: the Cento Camerelle, the Piscina Mirabile, the so-called Sepulchre of Agrippina. Its history is identified with that of *Baiae*, and consequently with the decline of the former there was also that of *Bauli*. Around 1600, a colony of Neapolitan Jews settled in Bacoli giving it new vitality, through an economy based on fishing, viticulture, and the working of stones in the tuff and pozzolana quarries. The city revived and attracted new travellers in the 17th-18th-19th centuries: it was the season of the *Grand Tour*. However, the imprint of modern Bacoli was mostly given by the urban development that took place in the second half of the 20th century. To date, the town has about 25,000 inhabitants. The town, in line with other neighbouring municipalities, has suffered from inadequate management and decision-making, which has led to a critical scenario. Contemporary buildings of inadequate architectural and urban quality have taken over the archaeological remains, resulting in a distorted landscape. The solution for Bacoli is not to enhance it as it is, but to address the serious issues that require a significant increase in the quality of the area. It involves restoring public spaces, promoting cultural and artistic initiatives, managing public transportation, and introducing pedestrian areas and bike sharing services. These interventions could transform the landscape of the Phlegraean Fields peninsula, improve the quality of life for residents, and attract visitors.



Figure 2 – Wiew of the city of Bacoli

2.1 Public Policy for a City on the Water

It is not a simple task to formulate a governance agenda for a city facing a situation of financial chaos and limited staffing, especially given the current context of post-pandemic difficulties and the threat of war at the country's doorstep.

Nonetheless, the city of Bacoli, a municipality on the northern end of the province of Naples, can boast a three-year program in which almost forty million euros have been put to use in the execution of over 30 public works, financed by regional, metropolitan, national and European sources, and (has realized over this same time period the definitive closure of over twenty shipyards). These local interventions are the result of the implementation of a political agenda that is characterized by utmost attention to environmental concerns and cultural heritage, the urgent need to recover the salient assets of the region's cultural treasure trove that had been effectively abandoned, and most importantly the desire to protect and recover the coastal landscape that had been laid to waste by fifty years of poor governance. The result of this political agenda is a coordinated and integrated strategy to regenerate urban and environmental spheres in such a way that no single intervention or action is executed in an isolated manner, but rather all such interventions are joined by a single, governing thread.



Figure 3 - Bicycle and walking path around the Lake Miseno



Figure 4 - The first Phlegrean university campus in Villa Ferretti in Bacoli

This integrated policy can be clearly seen, for example, in the interventions targeted at the Fusaro lake - to clean the various water outlets, to recover the perimetral path and the historical and archaeological elements that look onto the lake- which are combined with the cultural initiatives aiming to recover ancient uses and increase the value of its spaces.

The results can also be seen in the current state of the Vanvitellian compendium, the new safety conditions of the water grottos, the vast improvement of the parking areas, the construction of new bridges along the perimetral path and between the bank of the lake and the Royal Lodge. The efforts to rationalize the use of the city's existing public spaces are brought together with the construction of new spaces and the rehabilitation of abandoned buildings: a former school building which had been abandoned for a decade will now house homeless families, another formerly abandoned building will now house the local administration, and yet another will be home to religious communities.

A simple effort to clean and restore previously overlooked areas thus represents an opportunity to create new spaces where young families can come together: from the playgrounds of the Frutteto Borbonico and the Cuma residential area, to the long-abandoned Bellavista pitch. Similarly, a building confiscated from the local mafia in Baia has now become the first university campus on the Phlegrean coast, as well as becoming -thanks to the targeted financing- the most extensive archaeological land and sea research area in our region. Similarly, the interventions in Miseno finally resulted in the completion of the secured perimetral which had been left incomplete for twenty years, and the reopening of the Cinque Lenze area which had formerly been an abandoned military space. The disinfestation of weeds from the waters of this area have allowed for the reopening of this aquatic space as a recreational location, hosting

various local and national aquatic sport tournaments. Today there is efficient and coordinated rationalization of Bacoli´s coastal areas on an urban scale, with the possibility of connecting these coastal areas to each other by optimizing the public areas that separate them (some given over to military use, some abandoned, some improperly used). The result is a new urban design plan that allows the weaving together of Bacoli´s internal and external aquatic spheres, and the re-learning and re-writing of our territory´s dormant assets in such a way that they can see a new dawn.

The urban projects fielded are the result of a programmed technical translation of a political program that stands out for the attention paid to environmental issues, the priority given to cultural heritage, the need given to the recovery of disused and abandoned heritage, but above all for the attention given to the protection of the coastal landscape besieged in the last 50 years by short-sighted speculative policies. The strategy derived from the networking of these priorities has fine-tuned an integrated program of urban and environmental regeneration actions such that no intervention, action or strategy, realized, in place or planned is isolated, but all are linked by a single thread.

So that the interventions along Lake Fusaro to clean up the mouths, restore the circumlacustrine strip, and recover the historical and archaeological assets overlooking it are wedded to the cultural initiatives and recovery of ancient uses and enhancement of its spaces (from the Vanvitellian compendium to the securing of the Water Caves, from the improvement of the rest areas to the continuity given by the paths on new bridges between mouths and between shore and royal casino). Indeed, the last five years have seen remarkable efforts to bring to light archaeological discoveries of rare value, such as the new discovery on the seabed of the Submerged Archaeological Park of Baia, a new colorful mosaic covered by the sea, visible from boats that travel the gulf of Baiae and through organized dives, and the new discoveries of thermal environments in the Archaeological Park of the Baths of Baia.

So that interventions to rationalize the uses of municipal real estate are coupled with the creation of new housing and new services from the reuse of disused buildings (a school that has been disused for ten years will house new housing for indigent families and another will house the municipal headquarters, others partly house religious communities and other sicialian destinations).



Figure 5 – Ancient roman mosaic in the Submerged Archaeological Park of Baia

So that a simple cleaning, routine maintenance of forgotten areas becomes an opportunity for the creation of new gathering spaces for young families (from the play areas of the Bourbon orchard to the play area of the abandoned for years small field of the Bellavista Locality to the playground of the residential area of Cuma).

So that the Miseno area where only after twenty years since the realization of the curcumlacual promenade could be completed the circuit with a protected route and the area of the Cinque Lenze, a former military area abandoned for so many years and today the stretch of water is the playing field and scene of national and international water sports championships, could be opened by clearing away weeds.

Today there is reasoning for Bacoli, planning better consolidated and permanent uses of coastal areas especially at an urban scale, on the possibility of connecting together the many interlocking public areas (because military, because disused, because improperly used) in a new urban design that allows to stitch up, to reconnect internal and external water banks, to re-cognize and re-write the territory in its latent values, but waiting to be brought to light.

Fortunately, there are many cultural rewiring interventions in place in the municipality of Bacoli, small interventions that make a huge contribution to the perception and sustainable enjoyment of the Phlegrean landscape, public places long since taken from the community and private places redeemed from the underworld and made public. All in a vision of cultural restoration and respect for the identity of the place, for a sustainable tourist-cultural development of the place.

Regarding the issue of transportation, the municipality of Bacoli has shown considerable interest in the bicycle-pedestrian network, also known as the greenway network, particularly of the two circumfluous of Miseno and Fusaro.

More than 100 electric scooters have also landed on the Phlegrean town, with charging stations and stations distributed throughout the municipality. The municipal administration of Bacoli has proposed an expansion of the sea transportation service, as a sort of cumana of the sea, active from the summer of 2022 and stopping at the marinas of Torregaveta, Monte di Procida, Miseno and Baia, arriving at the port of Pozzuoli. In this sense, sea routes can help decongest and fluidify the flows affecting this highly urbanized area. An appropriate use of port infrastructures can allow an articulated fruition of the "sea resource" in the context of regional mobility and a fluidization of coastal flows through the enhancement of an "axis of the sea" that, by fitting into the Tyrrhenian connective system and the broader Mediterranean geocultural sphere, gives new centrality both to Campania's centres arranged along the coastal strip and to those pertaining to micro-insular realities. In this perspective, it is possible to enhance coastal centres, ancient maritime villages, or fortify the so-called cultural tourism, considered of fundamental importance to understand the Mediterranean nature of Campania's cultural and environmental heritage.

There are many interventions aimed at the redemption of public places that have been sadly abandoned and/or taken away from the community due to abuse by private concessionaires. It is the case of the beaches, for decades closed by grates and gates, now completely freed to protect the interests of the community itself. It is the case of Cerillo Park and Quarantine Park, green lungs long abandoned and now reborn and returned to the community through cooperative management between the public and private sectors, virtuous examples of the enhancement of urban spaces. The case study below, the rehabilitation of the “Cinque Lenze” site, is also in this perspective.

3 A punctual design for a territorial vision - the case study

3.1 Recovery project of Cinque Lenze site: Ecomuseum and sensory park for Bacoli

The choice of the proposed case study stems from the desire to respond to concrete needs that emerged from the analysis of urban voids in the Bacoli area, also identified by the PUC approved in 2021, whose need to be recovered and reintegrated into the territory is a priority. The intervention lot identified is the so-called "Complesso Cinque Lenze" an area of about 2.5 ha in size, a short walk

from the historic centre: this is a green area overlooking the southern shore of Lake Miseno, within which there are Navy buildings dating back to World War II, abandoned and in a state of advanced environmental and built degradation for over fifty years.



Figure 6 - Location of the "Cinque Lenze" site

The choice of the theme led to a process of field investigation, with the analysis of urban planning prescriptions, historical cartographies and with direct interviews, concluded with the application of the S.W.O.T. method, in order to identify the three basic principles that underlie the guidelines of the project.



Figure 7 – Ex-military site called Cinque Lenze

They are " naturality," because of the presence of protected green areas and floro-faunal qualities recognized at the regional and European level; "identity," because of the strong traditional connotation perceived in the scenario of the urban fabric and in the numerous points of historical and cultural interest; and

finally "sustainability," because the need of this territory is to be managed in a respectful, non-invasive way, so as not to disfigure the qualities that distinguish it, but, on the contrary, to enhance them and bring them back to an active state.

Therefore, it was decided to intervene with a design of "stitching up" the area through the design of an Ecomuseum: it is built on the network of existing water routes, which to date have not been connected to each other in an organic way, through an itinerary, made recognizable by a specific system of signs and custom-made elements of street furniture; the fulcrum of the intervention is represented by the Sensory Park and Nature Center, which is identified precisely in the area of the Cinque Lenze Complex. The Park has been designed to comply with sustainability requirements as best as possible: the goal is to reuse existing structures and re-functionalize them so that they can once again be used by the community. Indoor and outdoor functions have been incorporated within the Park. Indoors there are exhibition areas connected to the water paths of the ecomuseum, laboratory areas for the study and reuse of aquatic plants, a multifunctional area, an info point, a spa and wellness center, a bar/bistro where the sale of typical products made on site takes place, and a multifunctional exhibition space that also extends outside the building. Outside, the sensory park is developed, created with a series of common areas, docks serving sports and being, social gardens, and evocative nature trails that activate the visitor's senses, such as sight, touch, smell and hearing.

A representative element of the whole intervention is the use of marsh grasses as a multifaceted resource: marsh cane will be used as a technological material for thermal insulation of military pavilions, as an architectural material for the creation of furnishings and artistic installations, as a material for human activities in local craft workshops and creative and educational workshops, and as a material intended for natural phyto-purification of water and lake shores.

3.1.1 Goals and ecomuseum proposal

The on-site analysis revealed a high potential of the Phlegraean Fields territory and specifically of the area covered by this paper. The characters of the landscape denote the presence of a dense fabric of potential and interest, unfortunately not adequately exploited and little known.

What emerges, with regard to the area under investigation, is its difficult harmonization with the surrounding context, resulting as a place-non-place, alienated by barbed wire and unrecognized by the community, despite its

location so close to the neighboring attractive centers and the historical center, and the naturalistic and historical value it holds.

It was, therefore, possible to delineate the objectives of the project in an inevitable manner consistent with the analyses carried out:

- Reconnect the intervention site to the context;
- Refunctionalize and give new identity to the intervention site;
- Reuse local resources in the design phase;
- Reclaim the built environment as a visible example of green building;
- Recover the naturalness of the site.

Before starting the project to recover the site, it was considered appropriate to make a wider assessment of the territory and identify possible widespread ecomuseum paths, to enhance the cultural and environmental resources of the territory and connect these resources to the intervention site. In this way, it will be possible to reconfigure the functions of the site to make it a useful service to the Ecomuseum. The Ecomuseum is by definition an open-air museum, an open window on the history, culture and beauty of the territory, which is crossed and lived in a sustainable way with a quality cultural tourism.

So a proposal has been made for thematic ecomuseum tours based on the most representative element of the territory, water. The itineraries will be divided into six thematic paths linked to water, such as

- water walks to discover the water that accompanies the territory,
- the underwater path to explore the water that holds hidden treasures,
- the aqueduct path to know the water guarded and managed,
- the thermal path to discover the healing water,
- the waterways to live the water carrying
- the ways of taste to taste the fruits of water.

This will create a 360-degree experience for the enhancement of the cultural and environmental heritage linked to the water of the territory. The paths will cross the site of intervention and will be outlined indoor functions inspired by water paths.

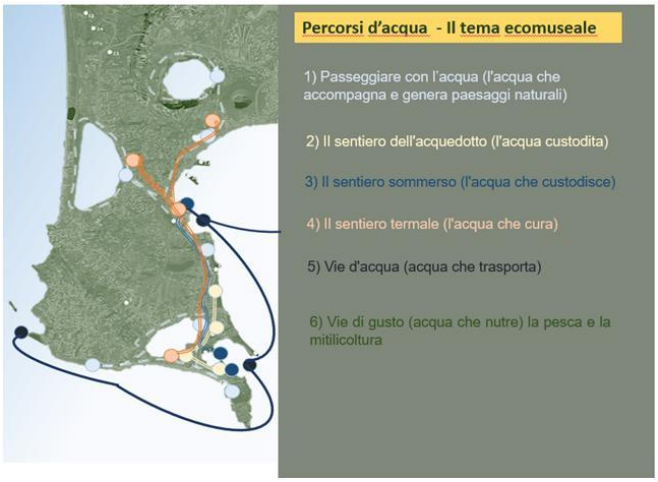

Figure 8 – Project proposal for six different water ways on the Eco-museum theme

3.1.2 Minimum sustainable actions

The Cinque Lenze area needs to be redeveloped from a landscape, naturalistic, structural and functional point of view with interventions aimed at mitigating environmental incidence and impact.



Figure 15 - Rendering for the reuse design of the beautiful area Cinque Lenze between lake and sea

A physical reconnection with the surrounding context will have to be arranged, opening the boundaries and harmonizing the relationship between the lake and the sea. As far as water is concerned, there will have to be limited artificialization

and soil sealing, allocating as much area as possible to permeable arrangements. In addition, the buildings to be repurposed should not undergo volumetric and height transformations, so as not to increase light pollution and not to alter the direction of the winds, which could have repercussions on the microclimate and habitat, such as to modify in an area already anthropized and sparsely populated by wild species, the natural balance of the habitat to the detriment of plant species, with consequences for those animals that live there. In order not to alter the current established balances and to improve building quality, consideration will be given to using eco-friendly building materials in compliance with recent regulations for the reduction of energy consumption and the color plan. The entire SIC area must be considered as the main junction of a system of ecological networks on a larger territorial scale and as such must be safeguarded in its naturalistic aspects and ecological connections with other junctions of the network must be protected.

Reconnecting the site to the context

In order to rediscover and recover the site's connection with the surrounding context and with the lake and the sea, a number of specific actions will be taken. First, the lot will be cleared of boundaries, remove architectural barriers such as barriers and barbed wire. Accessibility will be defined to see how the complex can fit harmoniously into the pre-existing context. The bike path will be extended into the lot by increasing its travel length, while the area of squatter parking lots bordering the south side of the lot will be eliminated to make way for a filtering forest connected with the maritime shoreline. The connection between the two bodies of water will be achieved through the construction of water portals, which are paths drawn transversely to the lot whose directions are oriented toward the islands of the gulf. The transverse walkways will be used as connecting elements of the two shorelines by becoming docks serving sports and being on the lake, viewing terraces and beach access paths.



Figure 10-11: Project paths

Pre-existing paths are preserved to minimize the impact on the area. The design will also take into account the paths marked by the footsteps of patrons who used a shorter route to travel between points on the site. Finally, the existing bike path will be connected with the lot and the coastal road in anticipation of the ZTL planned in the updated PUC. Possible paths, made of stabilized earth and marsh cane, will then be outlined as below. Driveway access will be allowed only on the lot adjacent to the Cinque Lenze Complex as parking for electric shuttles serving the community and for authorized vehicles. Thus, efforts will be made to minimize the presence of cars on the shoreline with the provision of parking areas served by an efficient and sustainable public transportation system.

Giving functions and new identity to the site

It is necessary to functionalize the outdoor and indoor spaces in order to give new identity and lifeblood to the intervention site. It was planned to create a sensory park through which one can experience the natural peculiarities of the context as well as include new covered functions inspired by and serving the ecomuseum trails, also suitable for knowledge and learning of crafts with local resources. This will give new identity to the site compatible with its vocation, stimulate knowledge of the area and intangible heritage of knowledge and encourage the maintenance of the site. Indoor and outdoor functions have been included within the park. Indoors there are exhibition areas connected to the water paths of the ecomuseum, workshop areas for the study and reuse of aquatic plants, a multifunctional area, an info point, a spa and wellness center, a bar/bistro where the sale of typical products made on site takes place, and a multifunctional exhibition space that also extends outside the building.



Figure 12 – Proposal for the refurbishment of the buildings functional to the ecomuseum

Outside, the sensory park is developed, along the lines of the KurPark in Villabassa (BZ) and the Parco della Masone in Fontanellato (PR) created with a series of common areas, docks serving sports and being, social gardens, and evocative nature trails that activate the visitor's senses, such as sight, touch, smell and hearing.

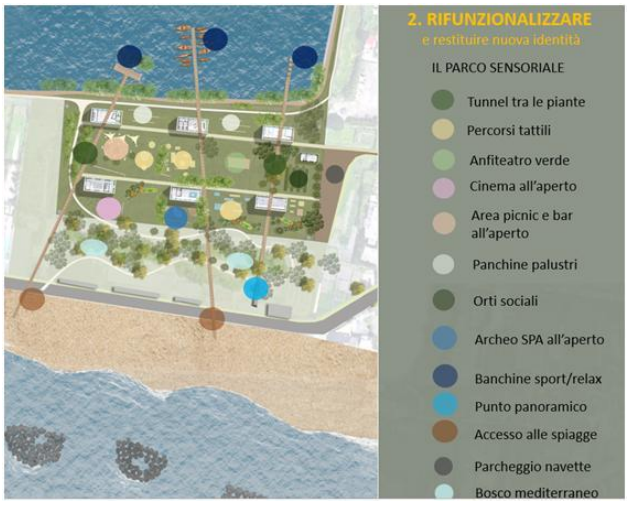

Figure 13 - The Sensory Park: design proposal about outdoor activities

Functionalization is also to be considered in relation to the paths that interpenetrate open and covered spaces, generating an osmotic relationship

between indoor and outdoor functions and consequently between nature and the built environment.



Figure 14 - Sensory park in "Kurpark" in Villabassa (BZ) as example to imitate

Using local resources

Central role plays local marsh grasses as design resources. Marsh reeds, particularly the native *Phragmites Australis* type, will be used/reused in the present project as:

- Architectural material: furniture elements and art installations, evocative and sensory pathways;
- Technological material: thermal and acoustic insulation panel made of swamp reed;
- Material for environmental restoration: natural Phyto depuration of the banks and waters of the coastal lagoon;
- Material for human activities: local crafts and environmental education activities.



Figure 15 – Different uses of marsh cane

Recovering the built as a visible example of green building

The buildings built by the Navy present in the "Cinque Lenze Complex" will be recovered entirely at the structural level, preserving the technological aspects typical of the industrial architecture of the 1940s, while, with regard to the infills, action will be taken to minimize the production of waste.



Figure 16 – Analisys of Cinque Lenze military architectures

The pavilions recovered with minimum sustainable interventions will be visible examples of green building thanks to the interventions with low environmental impact and the use of eco-friendly materials for energy upgrading. The buildings, therefore, in order to be salvageable need structural interventions to make the interior spaces habitable and energy upgrading to give them thermo-hygrometric comfort and sustainability in terms of energy savings.



Figure 17 - Design rendering

From the project, therefore, only local volumetric concrete recovery and reconstruction interventions and a shear and flexural reinforcement of the columns by affixing unidirectional natural fiber bandaging are planned.

Energy interventions are necessary since the quality of the sheds from this point of view is very poor being the building elements lacking thermal insulation for the dispersing surfaces. Starting from the analysis of the state of the building and identified the areas of intervention, it was assumed to implement a thermal

insulation system consisting of reed panels, a material that has good thermal insulating capabilities, is breathable, promotes the diffusion of vapor and is present in abundance in the vicinity of the site. The panels, with a thermal conductivity of λ = 0.050 W/mK, will be applied to the interior surface of the walls and roof in order to ensure energy savings without changing the exterior appearance of the structure. The intervention allows an improvement of four energy classes despite being minimally invasive and costly. The absence of wall insulation results in a high thermal bridge value (ψe = 0.463 W/mK) and possible presence of mold due to a very low internal surface temperature (13.93°C). By proceeding to insulate the entire dispersing surface, the thermal bridge value is greatly reduced (ψe = 0.015 W/mK) and there is no presence of mold. In fact, a more even distribution of temperatures within the wall is evident, as well as a higher surface temperature (18.86°C).

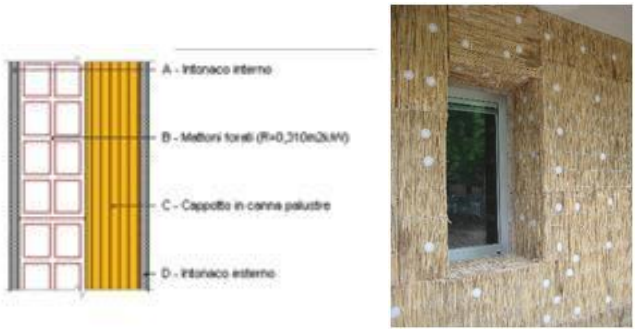

Figure 18 – Type of new insulation with marsh cane

In conclusion, the solution is effective in abating all problems related to thermal bridges in the structure. The intervention will not change the appearance of the building, configuring itself as a low-invasive and high-impact solution for the purposes of thermohygrometric comfort and energy savings.

Recovering the naturality of the site

It means reconstituting a nature park by replanting native vegetation, particularly Phragmites nativa australis.

Such an operation, which is necessary and unavoidable, will promote biodiversity and reconstitute habitat for the local fauna that is highly endangered. It will also naturally reclaim soils depleted by the presence of heavy waste poured over the past decades on the lake shores and in the waters.



Figure 19 - Design rendering of the Park

Native shrubs and plants, such as Phragmites australis, and native marsh grasses, aromatic bumps of biodiversity typical of the coastal lagoon Mediterranean scrub, forests of holm oaks and poplars, and white willows will be arranged within the Cinque Lenze Park, as shown in the following abacus of greenery:



Figure 20 – Design with green abacus

3.1.3 Economic sustainability and future prospects

The implementation of the present project will lead to strengthening the strengths elaborated in the meta-project phase. It will, in fact, go to protect and recover the flora and fauna of common interest, reconnect the site with the context by generating a harmonious relationship between the parts of the area, and encourage the influx of cultural tourism in line with the area.

In addition, the foreseen ante operam weaknesses will be resolved, with the elaboration of possible new weaknesses, such as the presence of the pest tree species in the area and the lack of a waste management plan.



Figure 21 - Design rendering

Regarding the sustainability of the project, on the other hand, it is necessary to assess its environmental and economic sustainability over time. It is taken into account that this aspect turns out to be crucially important and will need to be further investigated in the future by competent technicians in the field. However, a study on economic sustainability related to the implementation of this project has been prepared in general.

The funding required to carry out the work can be drawn from both public and private funds.

The public funds identified are the PNRR (National Recovery and Resilience Plan) and REACT-EU, the site being among the areas of the ROP2021-2025.

Private funds could come from Associations or entrepreneurs who would contribute through a PPP (Public Private Partnership) to implement and manage the planned commercial activities within the thesis area.

It was estimated, through a summary statistical analysis, about 2,000,000.00 euros in annual revenues from activities such as: Bar-bistro, SPA and wellness center, sale of km0 culinary and artisanal products, outdoor cinema, seminar room, sports activities (rental and lessons in sailing, kitesurfing, canoe windsurfing), bicycle rental, creative workshopscraft activities for children and adults, social gardens, against approximately 100,000.00 euros in expenses, in addition, the revenue to the public administration from the sale of these activities to private individuals would cover the cost of maintaining the green areas and equipment, estimated at around 200,000.00 euros annually.

4 Conclusions

Considering the strong responsiveness of the new municipal administration to the issues of sustainability, the green city and the knowledge management, in synergy with the higher authorities and with the arrival of new forms of public funding, it is clear there is an opportunity to implement sustainable planning to serve the cultural landscape for community benefit. This will result in greater awareness of the environment and consequential development of sustainable, low-impact tourism with continuous durability. In particular, the case study "Cinque Lenze site" restoration project can be an initial opportunity not only to regenerate the specific area identified, but also to improve the quality of life of the community and to preserve and enhance natural ecosystems on a larger territorial scale. The project would, with an analysis to be further investigated, be sustainable from both an environmental and naturalistic as well as an energy and economic point of view, respecting existing protection plans and promoting the preservation of naturalistic aspects and ecological connections with other sites in the system.

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The Circular Economy Provenance Effect

Vinicio Di Iorio*

Institute of Management.
Sant'Anna School of Advanced Studies
Piazza martiri della libertà, 33, 56127 Pisa - Italy

Francesco Testa

Institute of Management.
Sant'Anna School of Advanced Studies
Piazza martiri della libertà, 33, 56127 Pisa - Italy

Daniel Korschun

Department of Marketing
LeBow college of business, Drexel University
3220 Market St, Philadelphia, PA 19104 - USA

Natalia Marzia Gusmerotti

Department of Management and Law
Tor Vergata University of Rome
Via Columbia, 2, 00133 Rome - Italy

** Corresponding author*

Abstract

Used clothing carries a story to tell. While the circular economy emphasizes reusing, recycling, and recovering materials to minimize environmental impact, research is focused on technical aspects of circular products, such as materials composition and quality. However, little is known about the impact of a product's provenance on its value perceived. We argue that a product's previous owner can imbue it with a sense of value beyond its physical characteristics. Accordingly, we conducted a between-subject experiment to test this hypothesis. We compared two different background information settings, which we call *status provenance* (socialite vs no-frills previous owner), and the type of circular product (remanufactured vs second-hand). We found that remanufactured products, which are crafted by previous owners, had a higher perceived meaningfulness and purchase intention than second-hand products. Furthermore, the status provenance of the previous owner had a negative effect on perceived meaningfulness, suggesting that the focus should be on the crafting process rather than the identity of the previous owner. The

study's findings highlight the importance of recognizing the intangible, value-based aspect of remanufactured products, which can be an important aspect to promote to consumers and ultimately accomplish the transition towards a circular economy.

Keywords – Background information, Circular economy, Provenance effect, Second-hand, Remanufactured

Paper type – Academic Research Paper

1 Introduction

The circular economy emphasizes reducing environmental impact by reducing, reusing, recycling, and recovering materials in production and consumption (Kirchherr, Reike, & Hekkert, 2017). Circular products, particularly those that are repurposed or recycled, may present distinct value propositions to consumers due to their regenerative logic (Testa et al., 2022). Research has examined the technical aspects of these products, such as materials composition and perceived quality (Machado et al., 2019), but has largely overlooked the impact of the prior owner of the item. However, provenance has been shown to be a prominent feature for buyers in other markets, such as antiques and art (Feigenbaum et al., 2012), and early evidence suggests that even common goods like second-hand sneakers can increase in value with a compelling provenance story (Slaton & Pookulangara, 2022).

In fact, we argue that a garment that comes from someone else entails a story. Such a story then, can imbue the garment with a superior meaning for the person who buys it. To explore the value-based worth of remanufactured products, we conducted a 2 x 2 between-subject experiment to compare two different background information settings, which we call *status provenance*. The experiment employed a two-factor design: provenance information (socialite vs no-frills) about the previous owner, and the type of circular product (remanufactured vs second-hand). Each scenario depicted the same scarf, but with different combinations of information attached. Participants rated their level of agreement on items regarding uniqueness, meaningfulness, and purchase intention. Data were collected from the five largest countries in Europe: France, Germany, Italy, Poland, and Spain (n = 5,123).

The study's findings suggest that remanufactured products have a higher value of meaningfulness to respondents, which comes from the work of crafting the

product by the previous owner. This value increases the propensity to purchase such a product. On a theoretical level, the study acknowledges an intangible, value-based aspect linked to remanufactured products beyond the physical characteristics of the product. On a managerial level, promoting the knowledge that remanufactured products contain superior value may encourage consumers to prefer them over new products, thus promoting the transition towards a circular economy.

2 Literature review

2.1 Beyond technical aspects of circular products

The circular economy advocates for reducing, reusing, recycling and recovering materials in production and consumption in order to reduce environmental impact (Kirchherr, Reike, & Hekkert, 2017). More specifically, the regenerative logic underlying the circular economy suggests that repurposed and recycled items may present distinct value propositions to consumers. Some research has examined the factors that make such products appealing to consumers (Confente, Scarpi, & Russo, 2020; Magnier, Mugge, & Schoormans, 2019; Testa, Gusmerotti, Corsini, & Bartoletti, 2022), yet much of that research has concentrated on the perceived technical aspects of circular products, such as materials composition, quality perceived, and appeal (Machado, Almeida, Bollick, & Bragagnolo, 2019; Testa, Di Iorio, Cerri, & Pretner, 2021). For instance, recent research on second-hand products demonstrates consumers highly rate and are likely to purchase items made out of recycled plastic; however, the perceived value of the product is lessened by plastic worry (Testa et al., 2022).

Research is focusing on second-hand products, yet still lingering on branded ones (De Angelis et al., 2017; Testa et al., 2022), since brand embodies consumers' beliefs and perceptions, which are influential in consumption (Kim & Jang, 2016). Specifically, a positive image of a company brand can encourage customers to choose its products or services over competing alternatives, even when products are made out of recycled material (Testa et al., 2022).

2.2 Uniqueness, meaningfulness, and purchase intention of circular products: uncharted waters

Consumers' purchasing decisions are influenced by further, deeper, intangible factors, namely uniqueness and meaningfulness. Understanding their importance in purchase intention can help businesses tailor their marketing strategies and product offerings. Uniqueness refers to the distinctiveness of a product or service; more specifically, "the 'perceived uniqueness' of a product is the extent to which the customer regards the product as different from other products in the same category" (Tian et al. 2001, p.95). Research on about perceived uniqueness in customized products argue that, in addition to aesthetic and functional fit, the perceived uniqueness contributes independently to the utility a customer experience, especially when one is in need of uniqueness (Franke & Schreier, 2008). Another study by Hagtvedt and Patrick (2008) found that unique products can enhance the perceived value of a product and increase purchase intention. The study found that when consumers were presented with two products, one that was unique and one that was not, they were more likely to choose the unique product, even if it was more expensive. This suggests that uniqueness can be a powerful tool for businesses to differentiate their products and increase purchase intention.

Meaningfulness refers to the personal significance or relevance of a product to the consumer in terms of appropriateness and usefulness (Im et al., 2013). Studies on meaningfulness have argue that differentiation through meaningfulness has been linked to a superior customer satisfaction, since more meaningful products better fulfill consumers' needs and expectations (Im and Workman, 2004; Kim et al., 2013). Further research consumption-supportive package functionality shows that one underlying mechanism that aids in our understanding of the beneficial impact of such a package functionality on purchase intention is perceived product meaningfulness (Im et al., 2013). Henceforth, consumers are more likely to purchase products that are both unique and meaningful to them, as they perceive such products as more valuable and satisfying. However, scholars have not investigated the role of these products domains referring to circular products, neither second-hand not remanufactured products.

2.3 Uncovering the hidden value of used products

Perhaps surprisingly, the literature has not yet investigated the distinguishing feature of a handmade product – neither repurposed nor recycled – namely, the prior owner of the item. Beyond the technical aspects, there is reason to believe that the provenance of a product may affect its value. Provenance has already been documented as a prominent feature for buyers of antiques and art (Feigenbaum et al., 2012). Usually, these products gain meaning over time and through the history of the owners they have gone through. But it is not clear how provenance may affect more typical consumer items. Indeed, common wisdom suggests that resold items may lose value. Early evidence though has shown that even common goods can increase their value; for instance this is what researchers have found by looking into secondary sneakers markets (Slaton & Pookulangara, 2022). This discrepancy in the literature has yet to be explained.

We argue that there is an overlooked value that makes remanufactured products meaningful – the provenance story they entails. As humans, we are all moved by stories. Hence, we explore this value-based worth that circular products can entail. By doing so, we delved into products bearing a provenance, namely second-hand and remanufactured products. They both come from previous owners – someone who has worn it in the past and collected memories with it; someone, in short, who has attached an intimate bond to it. Therefore, our study aims at uncovering the embedded value of used clothing by testing:

1. Which type of circular product (second-hand vs remanufactured garment) is perceived as more unique and more meaningful and to what extent
2. Which type of status provenance (socialite/no-frills background information setting) is perceived as more unique and more meaningful and to what extent
3. Which of the two (uniqueness and meaningfulness) leads to higher purchase intention and to what extent

3 Method

3.1 Experiment design

According to those premises, we conducted a 2 x 2 between-subject experiment to compare two different background information settings, which we call *status provenance*. We employed a two-factor design: the provenance information (socialite/no-frills previous owner—factor 1), and the type of circular product (remanufactured/second-hand – factor 2). To manipulate each factor, two similar short vignettes were shown. Each scenario depicts the picture of the same scarf, yet with different combination of information attached. We picked the picture of a scarf since it represents one of the easiest garments we can either recraft from old garments or pass it down, being extremely simple. Each responded is randomly assigned to one out of four scenarios and asked to rate on a 1-to-5 scale his/her level of agreement on items regarding *uniqueness* (Franke & Schreier, 2008), *meaningfulness* (Vogt, Jenny, & Bauer, 2013), and *purchase intention* (Chen & Chang, 2013). Items were adapted to best fit the purpose of the study.

3.1.1 Sample

In order to test our experimental design, we selected a representative sample of the five largest countries in Europe: France, Germany, Italy, Poland, and Spain (n = 5,123), whose ages ranged from 18 to 70 years old, and whose age cohorts' proportions reflect those in the actual population. The survey was administered in January 2022 through an independent company that carries out online surveys, in order to reduce sampling error and reach a broader number of respondents.

Sampling takes place through pre-registered users on the provider's platform, who are invited to fill out a questionnaire if they meet the requirements - initial filters - and follow the established socio-demographic quotas. Invitations are sent by email. Each participant receives a link that sends it directly to the online platform where the actual compilation begins. The compilation is subject to various automatic checks to avoid: missing answers, inconsistent answers, low-quality answers, and answers that are unreasonably fast, or suspected to be given by a BOT. Respondents receive incentives. The incentive system allows participants to accumulate points, which can then be converted into digital rewards.

3.2 Results

Manipulation check was run to guarantee accountable responses. Specifically, we conducted a chi-square test to analyze contingency tables in order to determine whether there is a relationship between two categorical variables. Being the sample sizes large, we checked for Pearson's chi-squared test, since it is a specific type of chi-squared test. We outline two contingency tables; in the first one, we cross-tabulated *socialite vs no-frills* as categorical variables and manipulation check answers *yes vs no/don't know* as a manipulation check answers; in the second one, we replicated the same approach yet entered *remanufactured vs second-hand* as categorical variables and cross-checked them with their *yes vs no/don't know* answers. Pearson's chi-squared test was significant, showing p=.000.

After, we run an exploratory factor analysis to check whether the items reflect the variables they were supposed to represent. Principal-component factor loading retained 3 factors as expected: *uniqueness*, *meaningfulness*, and *purchase intention*.

Ultimately, regressions have been run to get the following results. Remanufacture provides meaningfulness (b=.1885609; SE=.05312; p<.000), which leads to purchase intention (b=.4825551; SE=.0099494; p<.000). However, status provenance has a negative effect on meaningfulness (b=.0714482; SE=.0533682; p>.1). The interaction between provenance status and remanufacture suggests that these processes are distinct (b=-.1097418; SE=.0751739; p>.1). Additionally, uniqueness impacts remarkable on purchase intention (b=.5715558; SE=.0127736; p<.000), yet is such a scenario remanufacture does not provide purchase intention anymore (b=.0430698; SE=.0322284; p>.1) and, eventually, status provenance hinders purchase intention (b=-.1818294; SE=.0322758; p<.000). See table 1.

Table 1: Effects of control variables, main effects, and moderator effects

Independent Variables	Equation 1 (DV = Meaningfulness)	Equation 2 (DV = Meaningfulness)	Equation 3 (DV = Meaningfulness)	Equation 4 (DV = Purchase Intention)	Equation 5 (DV = Purchase Intention)
Uniqueness					0.571*** (0.012)
Meaningfulness				0.482*** (0.009)	0.240*** (0.010)
Remanufactured	0.133*** (0.037)	0.188*** (0.053)	0.202*** (0.052)	0.171*** (0.037)	0.043 n.s. (0.032)
Provenance	0.016 n.s. (0.037)	0.071 n.s. (0.053)	0.071 n.s. (0.052)	-0.094** (0.037)	-0.181 *** (0.032)
Remanufactured x provenance		-.109 n.s. (0.075)	-0.113 n.s. (0.074)	-0.015 n.s. (0.053)	0.022 n.s. (0.045)
Poland			0.331*** (0.058)		
Italy			.165** (0.058)		
France			-0.008 n.s. (0.058)		
Spain			0.249** (0.058)		
Age			0.113 *** (0.013)		
Sex			-0.176*** (0.037)		
Adjusted R^2	0.02	0.02	0.03	0.3	0.5

Notes: N. of observations = 5,123. Cells include Coefficient (Standard Error). ** = p < .05; *** = p < .01; n.s. = not significant

4 Discussion and implications

The study's findings imply that remanufactured products entail higher value – meaningfulness – for the respondents. This value comes from the work of crafting the product by the previous owner. In turn, meaningfulness increases the propensity to purchase such products, no matter the status provenance.

The findings of this study provide important insights for both scholars and practitioners. On the scholarly front, this study highlights the importance of considering the intangible value of remanufactured products beyond their physical characteristics. This insight can contribute to the ongoing discussion on circular economy and sustainable consumption (Kirchherr et al., 2017; Confente et al., 2020; Testa et al., 2022), as it uncovers the unexplored value which used

clothing entails, and provide further empirical evidence supporting the appeal of circular products.

For practitioners, the knowledge that remanufactured products contain superior value can be a valuable marketing tool. Besides private reselling markets, companies can appeal to consumers who are looking for more sustainable and ethical purchasing options by promoting the fact that their products have been re-crafted. This can help companies differentiate themselves in the market and attract consumers by providing them with products with greater meaning and value. Furthermore, this study also suggests that companies may benefit from investing in the development of new business models that emphasize the value of remanufactured products. By adopting circular business models, companies can capture more value from their products and create new revenue streams, while also contributing to a more sustainable economy.

Overall, this study provides valuable insights into the potential benefits of remanufactured products and underscores the importance of considering both the tangible and intangible value of these products. Scholars and practitioners alike can use these insights to advance the discussion on sustainable consumption and circular economy, and to develop new strategies for promoting the adoption of more sustainable production and consumption practices.

4.1 Limitations and Avenues for further research

Interestingly enough, status provenance becomes statistically significant (although negatively relevant) to purchase intention when uniqueness is included in the regression. That suggested that when facing background information about the previous owner, we suspect, the value that comes from the work of crafting the product by the previous owner might be diminished. That opens interesting scenarios that deserve further investigation, such as whether that depends on the type of background information.

5 Conclusions

According to the study, it appears that remanufactured products hold a greater level of meaningfulness for respondents due to the craftsmanship of the previous owner. As a result, this increased level of meaning can lead to a higher likelihood of purchasing such products. On a theoretical level, this study acknowledges that there is an intangible, value-based aspect linked to remanufactured products

besides the physical characteristics of the product, such as the perception of quality, the aesthetics and so on, which are better known in the literature (Confente et al., 2020; Magnier et al., 2019; Testa et al., 2021, 2022). Furthermore, on a managerial level, knowing that a remanufactured product contains superior value can be an important aspect to promote to consumers. When consumers are aware that the product was re-crafted, they may prefer it over other products. This may tip the balance away from old fashion *buying-new* mantra, and promote the transition towards a circular economy.

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Leading Tourism Businesses through Digital Transformation

Daniela Carlucci*

Department of European and Mediterranean Cultures,
Environment and Cultural Heritage
University of Basilicata
Via Lanera 20, 75100, Matera, Italy

Antonio Lerro

Department of Mathematics, Computer Sciences and Economics
University of Basilicata
Via dell'Ateneo Lucano, 10, 85100, Potenza, Italy

Giovanni Schiuma

Department of Management, Finance and Technology
LUM University Giuseppe Degennaro
S.S. 100 km 18 – 70010 Casamassima (Bari) – Italy

Francesco Santarsiero

Department of European and Mediterranean Cultures,
Environment and Cultural Heritage
University of Basilicata
Via Lanera 20, 75100 Matera, Italy

Rosaria Lagrutta

Department of European and Mediterranean Cultures,
Environment and Cultural Heritage
University of Basilicata
Via Lanera 20, 75100, Matera, Italy

** Corresponding author*

Abstract

Technological advancements are progressively changing tourism value chains. Tourism value chains are transforming into global value ecosystems and for tourism businesses is

becoming essential to evolve their business model to ensure a smart, sustainable and inclusive tourism development and the adoption of innovation strategies which place the user, the citizen, or the tourist at the centre of the destination processes and value co-creation. This means not only adopting digital technologies to improve products and services but also changing and enhancing organisational culture, competencies, structure, leadership, operating model to be more agile, adaptable and innovative. Looking at management literature on digital transformation (DT) and DT in tourism sector, it emerges that the role and skills of leaders in guiding and inspiring their organisations to adopt and leverage digital technologies for creating new business models and value propositions, remain under investigated. By drawing on extensive literature on DT, the study briefly examines some key management issues regarding DT in tourism and discusses leadership traits that help organizations successfully navigate their transformation towards the absorption and exploitation of digital technological knowledge. Then, the research suggests some directions for future research.

Keywords – Digital transformation, management, leadership, tourism

Paper type – Academic Research Paper

1 Introduction

Culture and tourism represent a key source for growth, employment and social cohesion in a country and especially, in its rural and isolated inner areas and historical small towns, characterized by a widespread and remarkable cultural and natural wealth (e.g. Brandano and Crociata, 2022; Richards, 2021). Unfortunately, the recent pandemic has put a strain on culture and tourism industries, although in different ways across sub-sectors. Additionally, the undergoing energy crisis and the geopolitical instability are slowing down the recovery and growth of the sectors. In such scenario public and private actors operating in tourism ecosystems have to face several challenges and find new paradigms of development rooted in principles such as sustainability, smartness, resilience, and safety (e.g. Demartini et al., 2021; Duran and Uygur, 2022; Gretzel et al., 2015; Najda-Janoszka and Kopera, 2014). Among the key challenges there are building of more resilient, circular, and sustainable models of tourism, based on the use of digital technologies, and the development and implementation of smart and sustainable tourism policies (e.g. Hjalager et al., 2018; Topal et al., 2020). Therefore, the actors of cultural and tourism ecosystems are called to improve the quality of life of communities and tourists and increase the levels of cultural, creative and touristic services, pursuing smart and sustainable practices and riding

the emerging wave of the digital and green transitions. Digital technologies represent a key means to deal with these challenges. Artificial intelligence, internet of things, virtual and augmented reality, big data, neuromarketing techniques, data analytics, smart travel facilitation tools such as online booking, boarding passes, automated clearance gates and electronic validation, can be exploited to create innovative and smart tourism solutions, enhance cultural tourism and create personalized offers, improve the quality of the tourism experience, and facilitate a more inclusive socio – economic growth for all the stakeholders of tourism ecosystems (Ammirato et al., 2021; Dredge et al., 2018; Fereidouni and Kawa, 2019; Goodwin, 2018; Hjalager, 2010; Santarsiero et al., 2021). However, using digital technologies to change the way the organization operates, delivers value, interacts with customers and stakeholders, and adapts to the changing environment, is not straightforward. Tourism businesses, especially micro-businesses, tend to being focused on business survival, and risk averse with limited inclination for innovation and digital transformation (DT) (Meyer and Mayer, 2015). Moreover, tourism sub-sectors are different among them in terms of resources, access to finance, skills, culture, etc. This potentially influences approaches and ways of implementing DT. However, technological developments are progressively changing tourism value chains. Tourism value chains are transforming into global value ecosystems and for tourism business is becoming essential to evolve its business model, by leveraging DT, to ensure an intelligent, sustainable and inclusive tourism development and the adoption of innovation strategies which place the user, the citizen, or the tourist at the centre of the destination processes and value co-creation (Tussyadiah and Zach 2013). This means for tourism business not only adopting digital technology to improve its products and services but also changing its culture, structure, leadership, operating model and talent to be more agile, adaptable and innovative. Looking at management literature on DT and DT in tourism sector, it emerges that the role and skills of leaders in guiding and inspiring their organisations to adopt and leverage digital technologies for creating new business models and value propositions, remain under investigated (e.g. OECD, 2020; Pesonen, 2020). Yet DT is challenging and requires leadership and direction to be successful. Without a clear vision and goals, any DT project can quickly stall or fail. By drawing on extensive literature on topics connected to DT in tourism, the study briefly examines some key management issues regarding DT in tourism and discusses leadership traits that help organizations successfully navigate their transformation

towards the absorption and exploitation of digital technological knowledge. Then, the research proposes an outlook for future research.

2 Digital transformation in tourism

In the digital age, the capacity of a tourism organisation to produce a smart, sustainable, responsible and accessible offer requires the use of innovative digital solutions that connect organisations with the local environment and culture, and protect and promote its heritage and beauty, as well as an understanding and adapting to the changing consumers' needs. Nowadays, tourist is an experienced and well-prepared traveller who prefers and requires customised services tailored to his/her needs. Its habits and attitudes are even more digital, mobile and social based. Tourists use web and ICT tool as their primary source for searching or planning trips, customise travel experience, access information and review, benefit from lower prices and greater convenience. Additionally, nowadays tourists informed by digitally derived data, seek hyper-personalisation and customisation, experiences rather than just products, services or travel arrangements. They want to be involved in the production and/or design processes and co-create service with other customers, local communities, stakeholders, employees and entrepreneurs.

In such scenario, tourism businesses of all sizes have to be able to effectively answer such renewed requests and needs of their customers and stakeholders, rethinking services, products, processes, business models and embarking on digital transformation (DT) journey. Tourism businesses need to embrace DT as a strategic priority and a source of competitive advantage (Nonaka and Takeuchi, 2019). However, compared with other productive sectors, tourism presents a fragmented offer and its sub-sectors are inherently labour intensive, namely characterized by a value offer based on the direct contact with clients. Moreover, enterprises in the tourism sector, especially micro-businesses, have a reputation for being focused on business survival, and being risk averse with limited appetite for innovation, reluctant to innovation and digitalization (Meyer and Mayer, 2015). They are characterised by a lack of collaboration with stakeholders, and rapid turnover of employees and business failures (Weidenfeld et al., 2009). Moreover, tourism sub-sectors are different among them in terms of resources, access to finance, skills, culture, etc. The differences between the fundamental nature of tourism business subsectors such as the accommodation, travel and distribution

system, hospitality and related services, greatly influence their capacity and speed to implement DT. Additionally, the tourism sectors are characterized by a majority of businesses being single-person or family-owned small businesses with limited investment capabilities (Cooper, 2015; 2018). However, technological developments are progressively changing tourism value chains and the position of micro, SMEs or large within them requires an evolution of business model. Tourism value chains are transforming into global value ecosystems and it is essential to leverage DT to ensure an intelligent, sustainable and inclusive tourism development and the adoption of innovation strategies which place the user, the citizen, or the tourist at the centre of the destination processes and value co-creation (Tussyadiah and Zach 2013). Nowadays the innovation in tourism sector has to be technology enabled, human centred and user driven. Technology advancements enable human-centred and user-driven innovation. Digital innovation such as Artificial Intelligence, Internet of Things, Cloud, etc., Analytics, big data, cloud computing and other emerging and enabling technologies, along with new habits and customers' behaviours, have created new trends such as platformization, prosumerization and business virtualization (Gimpel and Westerman, 2012). Furthermore, technological advancements lead to a new way of thinking about destination configurations. The interconnection between physical and digital world allows for reimagining and customizing visitor experience, and enhancing new models of destinations such as rural areas, hamlets and other second-rate destinations. In this new context, DT in tourism organisation cannot be referred to the mere exploitation of digital technologies in daily tasks such as organizing travel, choosing a destination, planning an itinerary, booking flights and hotels, organising a virtual tour of a museum, offering the experience of discovering the digital twin of a monument, etc. It involves a more complex process opening up new and highly creative ways of delivering tourism services and enhancing the visitor experience, by taking advantage of digital advancements to handle transactions, capture and process information and data on tourism supply and demand, and improve and connect operations along tourism value chains and ecosystems. This requires refreshed ways of creating and delivering value, and the development or enhancement of new knowledge, skills, competencies, work practices and leadership.

3 Leadership for Digital transformation in tourism

3.1 The human side of digital trasformation

Capturing value from implementing DT is not straightforward. To date, many organisations that have embarked on DT have not yet achieved their expected outcomes from digital investments (LaBerge et al., 2022). This is because frequently organizations conceive DT as incorporating digital technology into all business areas and not as an organisational transformation requiring the management of digital technological knowledge together with other complementary knowledge assets (Schiuma et al., 2021).

DT's success is a complex process not merely related to adopting new digital technology solutions. It involves an organisation's transformation driven by acquiring and generating new digital technological knowledge (Guinan, 2019) and the creation of a receptive culture (Tabrizi et al., 2019) that allows to rethinking the working mechanisms by adopting new practices and refreshing business models (Ashkenas, 2015). In fact, whilst digital tools and technology provide possibilities for gains in efficiency and productivity if most employees do not have the mindset or knowledge and skills to enable change, any DT project or programme is destined to fail. The wider engagement of employees in DT process is, indeed, essential to develop organisation's capabilities in managing digital technological knowledge and mature a receptive organisational culture (D'Este et al., 2012). DT is a complex and multi-dimensional process that requires significant changes to an organization's operations, interactions, and value creation (Barton et al., 2018). It is not only tech enabled but also a human led process. It requires a continuous process of learning and unlearning, experimentation, adopting new processes, ways of working and mindset to thrive under continual change. Therefore, only the right meeting point between people skills, mindsets and competencies and the opportunity provided by complex digital tools to increase value for stakeholders, can generate successful DT. Shaping an organisational culture and organisational context for fostering, developing and managing digital technological knowledge requires leadership. Leaders and top managers are critical in governing organizational learning and transformation (Sathe, 2007). They guide organisations through the DT journey by rethinking old structures and processes, encouraging a culture of change and leading people to adopt a new

mindset, knowledge, attitudes and ways of working to thrive under continuous change.

3.2 Leading tourism organisations in Digital Transformation journey

Leadership plays a key role in organisation's digital transformation, especially with reference to the creation of a receptive culture that enables a digital transformation strategy to become reality (Hensellek et al., 2020; Kane et al., 2015; Oberer and Erkollar, 2018). The analysis of literature on successful cases of digital and traditional companies that have led the transformation towards digital-based business models highlights that leadership as the core management attribute in determining successful organisational transformation (Hensellek et al., 2020; Klein, 2020; Mccarthy et al., 2021; Pabst von Ohain, 2019; Sainger, 2018). Management literature suggests various labels to describe leadership styles that are effective in navigating organizational transformations. These labels denote a leadership capacity of activating, supporting and managing the processes of an organization's transformation. In particular, the notions of transactional, transformational, entrepreneurial and wise leaders are considered critical ones (Ardi et al., 2020; Bass and Riggio, 2006; Fernald et al., 2005; Mccleskey, 2014; Odumeru and Ogbonna, 2013). Transactional leaders use management by exception to set clear goals and expectations for their followers and to monitor their progress closely to ensure they meet the predefined standards (Bass, 1985). They motivate their followers by using rewards and punishments, with the main focus being achieving specific outcomes and targets (Bass and Riggio, 2006). This leadership style works well in stable and predictable environments where leaders can create clear procedures and guidelines to facilitate goal attainment (Bass, 1998). Instead of criticizing or punishing employees for their mistakes, transformational leaders see them as opportunities to learn and grow (Bass and Avolio, 1990). They use mistakes as a way to enhance and refine future outcomes. Transformational leadership is a style that builds on and enhances transactional leadership. Bass and Avolio's (1990) emphasize the importance of the transformational leader's behaviour and how it affects their followers, consisting of four key elements known as the four "I"s. These elements are idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. Idealized influence means that a leader can act as a role model and gain the trust and respect of their followers. Leaders must have the right traits

and communicate the organization's mission and values. Inspirational motivation means that a leader can set a captivating vision that inspires employees to join in achieving it. Leaders should also show optimism to increase their confidence and enthusiasm. Intellectual stimulation means that a leader can encourage employees to think creatively and innovatively and find novel solutions to problems. Leaders may also challenge employees to explore opportunities for improvement on their own (Shields, 2020). Lastly, individualized consideration means that a leader can provide customized support and guidance to suit each employee's unique needs and abilities. Leaders act as mentors to foster individual growth and development. Entrepreneurial leadership is a style that fosters innovation, risk-taking, proactiveness, autonomy, and competitive aggressiveness for individuals and companies to enhance their market adaptability, performance, and survivability. An entrepreneurial leader needs to align ambitious visions with the team's capabilities and create challenges that stretch the team's limits but do not overwhelm them. They are accountable for developing a persistent vision and building trust to achieve it while foreseeing and removing internal and external obstacles and engaging key stakeholders to facilitate its accomplishment. Moreover, an entrepreneurial leader must motivate and commit to realizing the vision through team-building skills and efficient use of scarce resources. Entrepreneurial leadership is regarded as suitable for dynamic and uncertain environments. This leadership style demands leaders to be creative, innovative, and adaptable, with a high tolerance for ambiguity and uncertainty. Wise leadership is a concept that considers the moral compass in today's digital world (Freeman et al., 2006) and empowers leaders to gain wisdom. A wise leader balances attention to detail and larger goals and creates social and economic value for the common good. Wise leaders act as informed decision-makers (Nonaka and Takeuchi, 2019) and cultivate practical wisdosm. They consider factors such as changing realities, time sensitivity, and both small-scale and broad perspectives when making choices. They strive for what is best for society and the company and adopt a sustainable approach. They are also capable of making informed decisions in complex contexts and driving digital transformation and innovation throughout the organisation.

In sum, transactional leadership rewards employees that achieve pre-defined goals, while transformational leadership inspires, motivates, and grows them; entrepreneurial leadership fosters innovation and risk-taking in dynamic and uncertain environments; and wise leadership highlights the importance of leaders

gaining wisdom and aligning their decisions with the values and purpose of their organisations. The above four leadership styles highlight the importance of different leadership dimensions and suggest the distinguishing features of the leadership required to drive organization in DT, i.e. digital transformative leadership. Digital transformative leaders create a corporate culture that promotes digital technological knowledge and continuous organisational change. They use digital technologies to prioritise and improve value creation for the company, either by establishing new businesses or enhancing existing ones. Digital transformative leaders possess a dynamic combination of mindset, attitudes, skills, and behaviors that make the strategic use of technology both feasible and beneficial (Sheninger, 2019). They need to perform three types of tasks for digital transformation (Heavin and Power, 2018): 1) strategic tasks, such as reimagining and re-engineering business processes, and creating new e-business models; 2) tactical tasks, such as aligning business processes with IT processes and developing digital management capabilities; and 3) operational tasks, such as identifying key skills for employees and exploring new databases and data analytic. In doing this, they have to be interested in leading people to work most effectively by exploitation and employment digital technological knowledge, not only for the organization, but also for the benefits of the society as a whole (Ahlquist, 2014). A digital transformative leader has to find, assess and implement the DT opportunities and influence the culture and mindset of the organization in a horizontal and diffuse way, inspiring change. He/she has to effectively communicate with employees at all levels, from top managers to frontline staff, to foster a culture of teamwork and trust, and encourage constant learning and innovation. This way, he/she can help ensure that all activities and processes, even if under DT, are aligned and that everyone is on the same wavelength.

Digital transformative leaders must also practice inclusivity in their digital transformation projects/programs. This practice of inclusivity is important to reduce employees' reluctance to technology and change. By involving them in the change process, they feel more responsible for the digital transformation initiatives and adopt them more willingly and actively. This is particularly crucial in service organisations, such tourism organisations, characterised by a high customer-centricity. As outlined by several scholars (e.g. Liden et al., 2014; Zheng et al. 2020) in service organisations, leaders have to set clear performance standards for their followers and act as role models of service behavior. Service

leaders have to inspire and motivate their followers to engage in their work and deliver high-quality service outcomes. In the field of tourism, empirical studies that look at leadership skills and positions in digital transformation are a few. Recently, Pesonen (2020) examined the digital transformation in tourism and how it impacts on leadership and management in tourism organizations. He suggested that digital transformation is a creative process triggered by knowledge management and knowledge transfer, which aims at creating new business opportunities and models. Xiang (2018) analysed the challenges and opportunities of DT in tourism and argued that digital leadership in tourism needs to align with customer-centricity, which is a top priority for tourism businesses. The scholar suggested that digital leadership in tourism encompasses developing a digital mindset, culture, and capabilities. Gretzel et al. (2015) explored the impact of digitalization on destination management and marketing and emphasized the importance of destination leaders adopting digitalization as a strategic tool for improving destination competitiveness.

To date the relationship between DT and leadership both in start-up, micro, small and medium enterprise tourism as well as in larger tourism businesses, remain under-investigated. Yet the development of smart destination and intelligent tourism solutions, is generating new challenges and opportunities requiring new leadership competencies and high level skills. In this vein several questions require further research, especially from an empirical viewpoint. Among them: what are characteristics and competencies of effective digital transformative leaders in tourism and how to develop them? Do these competencies differ in startup, micro, small and medium enterprise tourism and in larger tourism businesses? What knowledge, skills, competencies entrepreneurs and managers of tourism organisations perceive as crucial to drive their organisations in DT journey? How do leaders foster a receptive culture of DT in tourism organizations? What are the leadership styles and practices that foster a culture of innovation, learning and collaboration in tourism organisations? What are the challenges and barriers that leaders face in implementing DT in tourism and how to overcome them? How do leaders cope with the challenges and risks of DT in tourism? How do leaders collaborate with their organisation's stakeholders, other sectors and society to leverage the benefits of DT in tourism? What is the impact of DT on leadership roles and responsibilities in tourism and how to cope with them? These are a few open research questions concerning the understanding of how leadership can effectively support DT in tourism

organisations. They call for further research achievements about the rich and complex issues of "human side" of DT in organisations.

4 A research outlook

Leadership is essential in successful DT projects and activities. Without it, there is a high likelihood of failure. This doesn't mean that the right leadership is the only factor responsible for the success of DT. Collaborative effort between leaders and all the employees who are working for and on the transformation is crucial. However, having proper digital transformative leadership skills at all levels of an organization is just on piece of the wider mosaic of organisational and management issues to deal with to successfully navigate in DT journey. The challenges that tourism businesses have to face in their DT journey can vary significantly depending on several factors such as: type, size and the subsector the tourism businesses belong (Calvino et al., 2018; OECD, 2019); access to technologies, information, expertise, advice, mentoring and other resources and support (OECD; 2020); management and strategy-making capabilities (Rachinger et al., 2018); location of the business, the social and economic context, and the access and availability of digital technologies (Dredge et al., 2018). Therefore, unlocking the potential of digital technologies and DT in tourism requires a nuanced approach. Besides this, what is sure is that tourism businesses have a lot of room for improvement in using and applying digital solutions, although they may gain from ICT investments in other sectors by outsourcing some of their business activities, e.g. sales and online advertising (OECD, 2019).

From a research perspective, studies on DT in tourism businesses and the impact of leadership and management on the digital technologies adoption and exploitaion are still in their infancy (Pesonen, 2020). To date there are still several key knowledge gaps on which research should focus in the future, using both quantitative and qualitative research methods and numerous research questions should be deeply explored (Cabiddu et al., 2014; Gretzel et al., 2020; Pesonen, 2020). Among them: what is the impact of DT on tourism micro SMEs and their competitiveness, innovation and productivity? What are the challenges and opportunities of DT for different types of tourism businesses, such as hotels, travel agencies, attractions, etc.? What is the role of government and policy in creating the right framework conditions and support mechanisms for DT in tourism? What are the ethical, social and environmental implications of DT for

tourism stakeholders and destinations? What are the emerging trends and technologies that are shaping the future of tourism, such as the metaverse, industry 5.0, AI, etc.? What is the role of management and leadership in technology acceptance models and use of technology? How managing the whole process from the introduction of new technology in tourism to technology affordance?

These are a few open research questions in the management literature regarding the understanding of how tourism businesses can effectively set up, implement, and manage DT. They open the way for further research achievements about the rich and complex environment in which digital technologies advancements introduce new ways of thinking, working and building capabilities in tourism businesses.

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A Critical Analysis of the Integration of Life Cycle Methods and Quantitative Methods for Sustainability Assessment

Roberto Cerchione

Department of Engineering
University of Naples PArthenope
Centro DIrezionale Is. C4, 80143 Naples

Renato Passaro

Department of Engineering
University of Naples PArthenope
Centro DIrezionale Is. C4, 80143 Naples

Ivana Quinto*

Department of Engineering
University of Naples PArthenope
Centro DIrezionale Is. C4, 80143 Naples

* *Corresponding author*

Abstract

Life Cycle Assessment (LCA) and related methods have been widely used for sustainability assessment. However, the integration of these methods with quantitative methods such as mathematical models, statistical methods, and artificial intelligence has received less attention. This literature review aims to examine how these methods have been integrated to pursue sustainability assessment objectives. A systematic literature review was conducted using Scopus database. The search was limited to articles published in peer-reviewed journals from 1960 to 2022. The search keywords included Life Cycle Assessment, Social Life Cycle Assessment, Environmental Life Cycle Costing, Emergy Accounting, Sustainable Value Stream Mapping, mathematical methods, statistical methods, economic methods, simulation methods, building information modelling methods, and artificial intelligence methods. The literature review identified a total of 150 articles that addressed the integration of Life Cycle methods and quantitative methods for sustainability assessment. The majority of studies focused on the integration of LCA with mathematical models, statistical methods, and artificial intelligence methods. The studies demonstrated that the integration of these methods can improve the accuracy and reliability of

sustainability assessments. Additionally, several studies proposed novel methods, such as the integration of LCA with building information modelling and simulation methods. The integration of Life Cycle methods and quantitative methods has the potential to enhance sustainability assessments by providing more accurate and reliable results. However, the integration process requires careful consideration of the assumptions, data quality, and uncertainties associated with each method. Further research is needed to develop standardized guidelines for integrating these methods and to identify the most effective integration approaches for specific sustainability assessment objectives.

Keywords: Life Cycle Assessment (LCA), Quantitative assessment methods, sustainability assessment.

Paper type – Academic Research Paper

1 Introduction

Firms nowadays are adopting sustainability methods to assess the performance of purchasing, production and distribution systems. However, the rise of sustainability has questioned the explanatory power and usefulness of extant Life Cycle methods, including Life Cycle Assessment (LCA), social Life Cycle Assessment (s-LCA), Life Cycle Costing (LCC), EMergy Accounting (EMA), and Value Stream Mapping (VSM).

Life Cycle methods allow organizations to evaluate and improve the sustainability of their products and processes. However, these methods can benefit from the integration of quantitative methods used for decision-making, such as mathematical methods, statistical methods, economic methods, simulation methods, building information modeling methods, and artificial intelligence methods.

LCA is based on the fundamental tenet that all stages of a system or product's production, from resource extraction to final disposal, must be considered to effectively estimate the environmental impact of the system or product. LCA is the computation and assessment of the potential environmental impacts over the life cycle of a good, material, or service, as well as the ecologically relevant inputs and outputs.

S-LCA sheds light on the social repercussions connected to a product's life cycle, although it still lacks details and is still being developed. S-LCA was described by Andrews et al. (2009) as an assessment technique that aims to evaluate social and economic aspects of products and their potential positive and

negative impacts throughout their life cycle, which includes raw material extraction and processing, manufacturing, distribution, use, re-use, maintenance, recycling, and final disposal.

LCC identifies the total amount of money spent to support an object from its conception and manufacture until the end of its useful economic (White and Ostwald, 1976).

EMA is a thermodynamics-based and systems-oriented methodology providing an assessment of processes from the viewpoint of the environment (Odum, 1994; Raugei et al., 2014). All available energy (exergy) used both directly and indirectly to create a resource in the biosphere and to manufacture a good or a service for the economy is referred to as "eMergy" (spelled with a capital M). Therefore, all the thermodynamic effort necessary to produce a resource throughout time must be known to compute the resource's eMergy value.

VSM has its roots in lean management domain. VSM attempts to find waste in manufacturing processes and eliminate it in a way that is effective (Hines and Rich, 1997). The definition of waste originally came from an economic standpoint, emphasizing squandered time and inventory as signs of ineffective manufacturing systems. VSM has been modified to include more environmental (waste) indicators because of a growing awareness of the potent synergies between lean and green manufacturing.

Recently, there have been paradigm shifts in how companies assess sustainability. Firms are abandoning the idea that sustainability is mostly an internal process and they inflow external knowledge to renew firms' knowledge base and improve their sustainability performance.

Meanwhile, scholars found evidence that the integration of different methods is critical for assessing sustainability processes. Consequently, firms are nowadays devoting considerable effort to improving their sustainability assessment methods and especially through the integration of Life Cycle methods and quantitative methods, including mathematical methods, statistical methods, economic methods, simulation methods, building information modeling methods, artificial intelligence methods. Several studies have explored the integration of these methods in various contexts, including product design (Luo et al., 2021), supply chain management (Li et al., 2018), waste management (Yao et al., 2020), and sustainability assessment (Guan et al., 2021). These studies highlight the potential benefits of integrating these methods, including improved decision-making, increased transparency, and more holistic sustainability assessments.

With these premises, in the attempt to move the sustainability assessment literature streams forward, this study analyzes the integration of Life Cycle methods and quantitative methods to pursue sustainability assessment objectives. The aim is, thus, to systematize previous studies revealing the link between the adoption of sustainability assessment approaches and other more general managerial assessment methods, with reference to the decision-making methods. To achieve this aim, this literature review aims to analyze the current state of research on the integration of Life Cycle based methods and quantitative methods for decision-making. It will examine the existing literature on the integration of these methods, identify gaps and challenges, and provide recommendations for future research. In this paper, we focus on the following quantitative methods:

- *Mathematical methods:* are essential tools for solving problems and modeling complex systems in various scientific fields, including physics, engineering, economics, and computer science (Luenberger & Ye, 2008);
- *Statistical methods:* are a fundamental part of scientific research and data analysis, providing tools for summarizing and interpreting data, making predictions, and testing hypotheses (Gelman et al., 2014);
- *Economic methods:* are a set of quantitative tools and techniques used to analyze economic phenomena and make informed decisions;
- *Simulation methods:* are a powerful tool for modeling complex systems and predicting their behavior (Banks et al., 2005);
- *Building information modeling methods:* is a digital representation of a building or construction project, which includes information on its physical and functional characteristics;
- *Artificial intelligence methods:* is a branch of computer science that involves the development of algorithms and models that enable machines to perform tasks that would normally require human intelligence;

The remainder of the paper is structured as follows. In Section 2, we discuss the methodology adopted to collect and review relevant papers. Section 3 presents a summary of the findings, while Section 4 presents conclusions, implications and research limitations and future steps.

2 Methodology

To explore the sustainability assessment framework outlined in Figure 1, we followed the systematic review methodology presented by Tranfield et al. (2003), which identifies the use of transparent criteria in the selection of publications to review and outlines the phases to provide a replicable review. First, an initial list of keywords was set. The keywords emerged from an in-depth analysis of key documents defining life cycle methods (e.g., Guinee et al. 2011; Hellweg et al., 2014) and quantitative assessment methods (e.g., Ha and Krishnan, 2008), from the authors' experience in the field and from interviews with a panel of experts composed of sustainability consultants operating in different sustainable transition projects (Tasca, 2010). Two categories of keywords were defined, related to life cycle methods and quantitative assessment methods. An example of a string used to search articles in the Scopus database is: "*life cycle assessment*" OR "*LCA*" AND "*Analytic Hierarchy Process*" OR "*AHP*".

For an article to be eligible for consideration, it had to include one of the combinations of keywords from the first and the second categories in the title, abstract or keywords. The search ended on February 20th, 2023, and was conducted through the Scopus database. We limited our search to articles published between 1960-2022. The publishing journals, in addition to any other potential field, had to pertain to at least one of the following main fields, namely, business, management and accounting, economics and econometrics, decision sciences and finance. The review was limited to empirical peer-reviewed journal articles and neglected books, book chapters and conference proceedings. According to these selection criteria, an initial sample of 309 articles was retrieved. The titles and the abstracts of these articles were reviewed to exclude those articles that were considered to not be relevant for the research, thereby leaving 245 articles. We fully read the 245 papers, but only 150 were deemed suitable for consideration. The content analysis for the paper selection was guided by the following inclusion/exclusion criteria. First, the articles had to examine the interplay between life cycle methods and quantitative assessment methods. Second, the articles had to provide implications for the sustainability assessment field. Third, any articles presenting exclusively technical aspects without a managerial perspective were also excluded. Overall, the selection process was collaborative, with discussions on articles that were deemed to not fully meet all the criteria (Combs et al., 2010).

Figure 1 shows the sustainability assessment framework adopted. Particularly, it is worth underlining that it presents only macro-categories of quantitative assessment methods, but not the single approach and methods considered in each of these. Also with regard to the life cycle assessment approaches, Figure 1 does not show the combinations of methods considered in the search in the Scopus database.

Figure 1. Sustainability assessment framework

Quantitative assessment methods	**Life Cycle assessment methods**				
	LCA	**LCC**	**S-LCA**	**EMERGY**	**SUS-VSM**
Mathematical methodology					
Economic methods					
Building information modeling methods					
Simulation methods					
Statistical methods					
Artificial Intelligence methods					
Mathematical methodology					

3 Findings

In the following subsections, we present the life cycle methods across the quantitative assessment methods, reflecting each cell of our sustainability assessment framework.

3.1 Mathematical methods

3.1.1 Multi-criteria decision making (MCDM)

The use of multi-criteria decision-making (MCDM) methods is a useful approach to evaluate the environmental impact of products, production processes, and other human activities. MCDM allows for a comprehensive product evaluation by considering environmental, economic, and technical criteria. The integration of MCDM with LCA has been applied in several studies, (Vukelic et al., 2017; Yoris-Nobile et al., 2022; Kamble et al. 2017). The combination of MCDM and LCA provides a systematic approach to estimate environmental risks/impacts, costs, and the technical feasibility of processes, allowing decision-makers to select optimal solutions.

3.1.2 Multiple-attribute utility theory (MAUT)

In decision theory, a multi-attribute utility function is used to represent an agent's preferences for bundles of goods under both certain and uncertain conditions. Rochat et al. (2013) combined three evaluation methods, MFA, LCA, and MAUT, to support the selection of the best end-of-life scenarios for PET waste in a developing country's municipality. MFA analyses the material and energy balance of a business, region, or nation, identifying the most relevant processes; LCA evaluates multiple environmental impacts of a product or service from cradle to grave; and MAUT allows for the inclusion of other aspects along with ecological ones in the evaluation.

3.1.3 Data envelopment analysis (DEA)

Data Envelopment Analysis (DEA) is a non-parametric method used to estimate the production frontier in operations research and economics (Cooper et al., 2007, Vázquez-Rowe et al., 2010, Vázquez-Rowe and Tyedmers, 2013). It provides a mathematical programming method to estimate the production frontier of best practices and evaluate the relative efficiency of different entities (Bogetoft and Otto, 2011). DEA is widely used in the fields of economic efficiency estimation research (Ferreira et al., 2021), regional economics (Ibrahim et al., 2021), optimal resource allocation (Ibrahim et al., 2019), sustainable development (Amin et al., 2022), performance evaluation (Amaral et al., 2022, Cetrulo et al., 2020), and risk assessment (Hu et al., 2018). The advantages of this method include: (1) it can process more input and output data and obtain a single efficiency value; (2) no specific assumptions are required; (3) there are no restrictions on the units of measure of inputs and outputs; (4) it allows the calculation of the relative efficiency of points with respect to a given data set (Cooper et al., 2007). In recent years, the scientific community has used the joint application of LCA and DEA to identify and quantify the potential environmental consequences of operational inefficiency (Mohseni et al., 2018, Venkatesh et al., 2018). This type of mash-up has a unique preponderance. That is, while LCA collects inventory data and evaluates the environmental impacts of DMUs, DEA uses this information to individually evaluate their eco-efficiency. In addition, DEA provides individual environmental and economic targets for improving inefficient DMUs based on best practices. Previous studies have demonstrated the feasibility and effectiveness of combining the two methods in research fields related to

industrial ecological eco-efficiency (Avadi et al., 2014, Vázquez-Rowe et al., 2010; Mohammadi et al., 2013, Mohseni et al., 2018, Masuda, 2016, Nabavi-Pelesaraei et al., 2017, Rybaczewska-Błażejowska and Gierulski, 2018).

Moreover, in cases where the number of evaluated structures (rafts) is high, the interpretation of results becomes rather difficult if LCA is used alone. According to it, Lozano et al. (2009) demonstrate the adequacy of the joint application of LCA and DEA tools, contributing to facilitating and enriching the discussion and interpretation of results by combining strengths and minimizing weaknesses attributable to both methodologies.

From the scientific literature, articles have also been found that combine Emergy Analysis (EA) and Data Envelopment Analysis (DEA) (Mwambo et al., 2020; Liu et al. 2019; Martín-Gamboa et al. 2016). Other studies combine Emergy Analysis and Dynamic Data Envelopment Analysis (DDEA) for the eco-centric evaluation of multiple similar entities over a prolonged period. The combined use of Emergy Analysis and DDEA is considered a valid methodological framework for calculating resource efficiency and evaluating ecosystem services.

3.1.4 Analytic hierarchy process (AHP) and Analytic network process (ANP)

Analytic Hierarchy Process (AHP) is a multicriteria decision-making support technique developed in the 1970s by mathematician Thomas L. Saaty. Professionals can benefit from LCA + AHP to obtain better results in their studies and provide more practical solutions. In addition to the LCA, the LCC has also been integrated with AHP (e.g. Goussous et al. 2014; Xu et al. 2019).

Analytic Network Process (ANP) is a more general form of the Analytic Hierarchy Process (AHP) used in multi-criteria decision analysis. The AHP structures a decision problem into a hierarchy with a goal, decision criteria, and alternatives, while the ANP structures it as a network. In the study of Kek and Vinodh (2016), LCA integrated with ANP is used for selecting sustainable production processes by comparing injection molding (IM) and selective laser sintering (SLS) processes, identifying IM as the most sustainable process for higher production volume. Specifically, LCA is used to calculate the impact score and ANP is used to calculate the sustainability score of the Single Point Production Sustainability Score (SPPSS) process.

3.1.5 Decision making trial and evaluation laboratory (DEMATEL)

Decision making trial and evaluation laboratory (DEMATEL) is considered an effective method for identifying cause-effect components of a complex system. It involves evaluating the interdependent relationships between factors and identifying critical ones through a visual structural model. Life cycle thinking is becoming increasingly important in addressing sustainability challenges within supply chains. In this regard, LCA has been widely used for assessing the environmental impacts of product systems; however, traditional LCA methodologies have various limitations. Blockchain technology offers great potential to overcome these limitations, but its adoption is hindered by various factors. For instance, the study by Farooque et al. (2020) aims to identify and prioritize barriers to blockchain-based LCA. Additionally, fuzzy DEMATEL was used, an extension of fuzzy sets to the standard DEMATEL technique, which can handle intrinsic biases and vagueness in human judgments. The prioritization of the identified barriers through DEMATEL provides a systematic way of analysing how to overcome the barriers.

The VSM method is very effective for the environmental and economic performance of production processes. Aouag et al. (2020) integrate VSM and fuzzy DEMATEL, using the former for data collection and process evaluation and the latter for analysing the current state map. The implementation of the proposed approach provided ample room for improving the economic and environmental aspects of production processes. The development of the extended VSM method helps to assess and control the economic and environmental performance of production processes.

3.1.6 Linear programming (LP)

Linear programming (LP) is a branch of operations research that deals with the study of algorithms for solving linear optimization problems. LCA is also useful in waste management and food waste reduction, as shown by Laso et al. (2019), who use LCA combined with linear programming LP. Since 1990, LP has been combined with Life Cycle Assessment-Ment (LCA) to aid decision-making in sustainability studies (Steubin et al., 2016) or even to tackle the problem in reverse, i.e., estimate the value intervals in which the weights associated with a set of environmental impacts must be present (Cortés-Borda et al., 2013).

Again, Budzinski et al. (2019) also aim to demonstrate, through an example of biorefineries, how LCA can be improved by using linear programming (LP) (i) to determine the optimal choice among new technologies, (ii) to identify the optimal region to provide the raw material, and (iii) to deal with multifunctional processes without specifying a particular main product. By combining the LCA and consequential LCC objectives within a linear programming approach, it is possible to address environmental and economic trade-offs in the resulting decision-making process.

3.1.7 Mixed integer linear programming (MILP)

An integer programming problem is an optimization or feasibility mathematical program where some or all variables are constrained to be integers. In most literature, the goal of studies is to simplify LCA studies by reducing the number of impact categories to evaluate. The integration of LCA and MILP optimization methods could lead to significant time and resource savings associated with data collection. Additionally, this work opens new avenues for the development of more effective environmental regulations that focus on controlling a limited number of key impacts. Finally, the MILP formulation allows for finding a global optimum without significant computational difficulties.

3.1.8 Fuzzy set theory (FST)

Fuzzy logic is a logic in which a degree of truth between 0 and 1 can be assigned to each proposition. It is a many-valued logic, an extension of Boolean logic, and is related to the theory of fuzzy sets. Besné et al. (2018) present an eco-efficiency analysis methodology that takes into account life cycle assessment (LCA) and fuzzy logic. The aim is to integrate economic and environmental impact categories using fuzzy treatment and obtain the fuzzy eco-efficiency index. Thanks to this study, the validity of the proposed methodology has been validated. Fuzzy set theory is a research approach that can address problems related to ambiguous, subjective, and imprecise judgments, and can quantify the linguistic aspect of available data and preferences for individual or group decision-making processes (Shan et al., 2015a).

reveal the usefulness of the fuzzy-based approach in quantifying long-term spare parts management costs.

The VSM-fuzzy integration model has been applied in various fields in the Rathore et al. (2022), Liu et al. (2020), Seyedhosseini et al. (2013) papers, as a tool

that integrates lean and ergonomics to improve worker health and safety, together with operational performance in small and medium-sized enterprises, to improve the VSM methodology. Moreover, Taskhiri et al. (2011) and Reza et al. (2013) papers explore the usefulness of fuzzy-based methods in emergy synthesis.

Generally speaking, results indicate that fuzzy-based modeling can provide a better understanding for both emergy and LCA professionals.

3.1.9 Multi-objective optimization

Multi-objective optimization is a branch of mathematical optimization that specifically deals with optimization problems with multiple objective functions. According to Lourenço (2020), LCA should also be included in a problem of optimizing costs and environmental impact of a CCPP. The novelty of this work is in the methodology itself, namely the simultaneous application of a fuel, equipment and emissions LCA and a cost estimation in the optimization problem formulation.

3.2 Statistical methods

3.2.1 Analysis of variance (ANOVA)

Analysis of variance is a set of statistical techniques that are part of inferential statistics that allow for the comparison of two or more groups of data by calculating and comparing the variability within these groups with the variability between groups. The ANOVA methodology has been used in conjunction with LCA in two papers by Mousazadeh et al. (2020) and Verbitsky et al. (2018) with the aim of minimizing the initial and life cycle cost of the building while simultaneously improving the seismic performance of the base-isolated structure. According to the results, the proposed approach proves to be effective in reducing the initial cost and life cycle cost of the building with an acceptable amount of computational effort.

3.2.2 Correlation

In statistics, a correlation is a relationship between two variables such that each value of the first corresponds to a value of the second, following a certain regularity. In these papers, the correlation between input parameters and the outcome of an uncertainty analysis performed for an LCA (Bojacá et al. 2010,

Groen et al. 2017) is analysed. Correlation is also used with the s-LCA methodology in the work of D'Eusanio et al. (2022). This work shows that, although the distinction between the two methodologies is clear from a theoretical point of view, when the existing differences are implemented, they become blurred.

3.2.3 Regression

Regression formalizes and solves the problem of a functional relationship between variables measured based on sample data extracted from a hypothetical infinite population. The studies by Balugani et al. (2021), Grant et al. (2016), and García et al. (2019) examine the use of inferential statistics, particularly multivariate correlation and regression, as a means of interpreting LCA data. The use of inferential statistics provides useful information regarding the strength and statistical significance of correlations between variables, as in multivariate correlation, and allows for impact predictive capabilities, as demonstrated through regression analysis. The result is that these equations allow for simple and rapid estimation of very different scenarios that reflect the reality of different farms at present, but also future scenarios based on the implementation of technologies that will reduce both feed and fuel consumption.

3.2.4 Factor analysis

Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors. Factor analysis (FA) and latent class analysis (LCA) methods were studied in the document by Cao et al. (2021). Factor analysis is useful for understanding which foods are consumed in combination and for studying associations with biomarkers, while LCA is useful for classifying individuals into mutually exclusive subgroups and comparing disease risk between groups. Factor analysis was also combined with the LCC methodology in the document by Shamsuddin et al. (2021), which highlights a study result simulating the causal effect relationship between IBS cost factors and LCC cost distribution.

3.3 Economic methods

3.3.1 Activity based costing (ABC)

Activity Based Costing (ABC) is a method of studying an industry or business that provides data on the actual costs associated with each product and service sold by the company, regardless of its organizational structure. In the three documents Jourdaine, et al. (2021), Tsai, et al. (2015), Tsai, et al. (2014), the integration of Life Cycle Assessment (LCA) into an Activity-Based Costing (ABC) cost determination model to develop a guidance system for the electrical and electronic industry or for CO2 emission costs and low-carbon construction methods has led to very encouraging results to help construction company managers better understand how to allocate resources and funding for energy-saving activities to each green building through appropriate cost drivers.

3.3.2 Return on Investment (ROI)

ROI is a financial index that measures the profitability and economic efficiency of a business irrespective of the sources utilized. It determines how much capital invested in a company is generating revenue. The analysis of ROI has been combined with Emergy methodology to consider the environmental impact of energy resource exploitation and assess the energy return on investment (EROI) more effectively. EmEROI has the potential to be used as an integrated aspect of energy resource exploitation project assessments. Chiriboga et al. (2020) combined LCA and Emergy analysis to determine the EROI of bioethanol and biodiesel in Ecuador. They evaluated the entire production chain by statistically processing primary and secondary information. The results suggest that EROI can serve as a technical criterion to minimize the impact on other energy resources and economic sectors.

3.4 Simulation methods

3.4.1 Monte Carlo

The Monte Carlo method is a broad class of computational methods based on random sampling to obtain numerical results. It can be useful in overcoming computational problems associated with exact tests. In the papers by Sun et al. (2020), Vinodh et al. (2014), Hongxiang et al. (2013), Peters, G.P. (2007), the use of a combination of life cycle assessment (LCA) and Monte Carlo simulation to

evaluate potential environmental benefits in various areas is described. It is noted that through the study and research of the integration of these two methodologies, similar results have been obtained for all documents. The results show that the model is able to evaluate the potential reusability of used products, while the use of simulation significantly increases the effectiveness of the model in dealing with uncertainties. System dynamics is an approach to understanding the behavior of complex systems over time.

3.4.2 System dynamics

System Dynamics analysis is also integrated with the VSM methodology in the article by Stadnicka et al. (2019), observing how integration can increase the possibilities of waste identification and elimination. The article demonstrates that the proposed extended VSM can be used as a single data source for building a computer model of a production line. The paper also argues that the integration of VSM and SD not only enables the identification and elimination of waste but also understanding the impact of identified issues on WIP and production volume.

3.4.3 Discrete-event simulation

A discrete event simulation models the operation of a system as a (discrete) sequence of events over time. The VSM methodology is also used in the papers by Abidee et al. (2021) and Aziz et al. (2017), studying integration with Discrete-Event Simulation to enable dynamic quantification and visualization of the future state of a value stream map of warehouse supply chain and to improve productivity of road paving operations by achieving high production rates and minimal road closure times. A hybrid DES-VSM approach ensures an integrated approach to process optimization.

3.5 Building information modeling methods

3.5.1 Building information modeling (BIM)

Building information modeling (BIM) stands for a method for optimizing the planning, construction, and management of buildings using software. Through it, all relevant data of a construction can be digitally collected, combined, and linked. The Building Information Modeling methodology is integrated with LCA in six documents (Morsi et al. 2022, Cheng et al. 2022, Abdelaal et al. 2022, Bueno et al.

2018, Najjar et al. 2017, Hollberg et al. 2020) applying the methodological combination in different fields. The common results identify BIM-LCA integration as an optimal procedure to achieve sustainable development and environmental protection and enhance decision-making processes in the construction sector.

3.6 Artificial intelligence methods

3.6.1 Machine learning

Machine learning is a branch of artificial intelligence that encompasses methods developed in various scientific communities over the last few decades of the 20th century. The interaction of LCA methods and machine learning (ML) in the studies of Akhshik et al. (2022), Karka et al. (2022), and Ghoroghi et al. (2022) has highlighted that ML-informed LCA based on dynamic data paves the way for more accurate LCA, supporting the decision-making process of the life cycle. Machine learning methods have been demonstrated to be efficiently applied in optimization scenarios in LCA and have been integrated as part of existing inventory databases to simplify LCA in many use cases.

3.6.2 Neural networks

In the field of machine learning, an artificial neural network is a computational model composed of artificial "neurons," loosely inspired by the simplification of a biological neural network. The integration between LCA and artificial neural network has been applied in several case studies with application in different sectors (e.g. tomato-based cultivation, lentil cultivation) (Elhami et al. 2017; Ozbilen et al., 2013; Pishgar-Komleh et al., 2020).

3.6.3 Genetic algorithms

A genetic algorithm is a heuristic algorithm used to try to solve optimization problems for which no other efficient algorithms of linear or polynomial complexity are known. In the documents by Mousavi-avval et al. (2021), Gheibi et al. (2018), and Khoshnevisan et al. (2015), the use of LCA methodology combined with the multi-objective genetic algorithm was analyzed. Often, these two methods are further combined with additional techniques, such as adaptive neuro-fuzzy inference system, a multi-objective genetic algorithm, and metaheuristic genetic algorithm approach.

3.6.4 Adaptive neuro-fuzzy inference system (ANFIS)

Khoshnevisan et al. (2014), Nabavi-Pelesaraei et al. (2019), Mousavi-avval et al. (2021), and Moayedi et al. (2020) used the LCA methodology and the ANFIS to predict environmental impacts in different fields. The common results in these papers demonstrate the usefulness of the multi-level adaptive neuro-fuzzy inference system for long-term management planning in predicting various environmental, energy, and economic indices of large-scale food production systems.

4 Conclusions

This study reveals that the integration of life cycle methods and quantitative methods for sustainability assessment is a rapidly evolving field that has attracted significant research interest in recent years. The review highlights that there is a wide range of methods and approaches available for integrating life cycle methods and quantitative methods, and these methods are being applied across a variety of sectors and domains, including manufacturing, energy, transportation, and agriculture. The review also shows that the integration of these methods can improve the accuracy, robustness, and transparency of sustainability assessments, and can help stakeholders make more informed decisions that balance economic, environmental, and social considerations.

The review found that the integration of Life Cycle methods with quantitative assessment methods offers a comprehensive and holistic approach to sustainability assessment. These methods provide a framework for assessing the environmental, social, and economic impacts of products and systems over their entire life cycle, leading to more informed and sustainable decision-making.

The review also identified some challenges in the integration of these methods, such as the complexity and data requirements of Life Cycle methods, the need for expert knowledge and skills, and the need for harmonization and standardization of the assessment methods.

The review identifies several future research directions that can help advance the field of sustainability assessment. First, there is a need for more research on the application of these methods in specific domains, such as food systems, water management, and construction. Second, there is a need for research that compares different methods and approaches to identify the most effective and efficient ways to integrate life cycle methods and quantitative methods. Third,

there is a need for research on the use of emerging technologies, such as artificial intelligence and big data analytics, in the integration of life cycle methods and quantitative methods.

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The European Digital Decade and the Tourism Ecosystem: A Methodological Approach to Improve Tourism Analytics

Simone Corrado*

School of Engineering
University of Basilicata
Viale dell'Ateneo Lucano n. 10, 85100 Potenza

Rachele Vanessa Gatto

School of Engineering
University of Basilicata
Viale dell'Ateneo Lucano n. 10, 85100 Potenza

Francesco Scorza

School of Engineering
University of Basilicata
Viale dell'Ateneo Lucano n. 10, 85100 Potenza

* *Corresponding author*

Abstract

Tourism is a complex and multidimensional phenomenon that involves social, cultural, and economic dimensions. While the economic benefits of tourism are often studied, there is a lack of a solid methodological framework to measure the impacts of tourism on other components such as the environment and cultural heritage. The tourism ecosystem is a network of resources and operators that spans across different domains and industries. This ecosystem is especially important for inland areas, where tourism can drive socio-economic development and prevent land abandonment. However, the COVID-19 pandemic has severely impacted the European Union's economy, including the tourism industry. Small and medium-sized enterprises (SMEs) have been hit hard, with many planning significant cuts in investments after the pandemic. In response, the EU has proposed a renewed New Industrial Strategy to support investments and strengthen the resilience of the EU Single Market. As part of the TechForYou project aimed at promoting and strengthening collaboration in the Calabria and Basilicata Regions, a data-driven approach using Artificial Intelligence and GeoAI is proposed to monitor tourism trends in inland areas in near real-time. The approach focuses on analyzing the huge flow of data

and information regarding tourism in a territorial/spatial dimension, and characterizes tourism as a relational phenomenon in a territorial perspective. The European Digital Decade initiative aims to improve Europe's competitiveness and ensure that European citizens can fully benefit from the opportunities offered by digital technologies. A single data space with a standard-based structure among all European countries will be established as part of the European Data Strategy, which will include the tourism ecosystem. This will facilitate the sharing of European data in key economic sectors and create a vibrant data-driven economy. In conclusion, a solid methodological framework is needed to measure the impacts of tourism on all components, including the environment and cultural heritage. The tourism ecosystem is a network of resources and operators that spans across different domains and industries, and a data-driven approach using AI and GeoAI can be used to monitor tourism trends in inland areas. The European Digital Decade initiative will establish a single data space with a standard-based structure for the tourism ecosystem, facilitating the sharing of European data and creating a vibrant data-driven economy. The tools derive from the ML and AI and the perspective to exploit the informative potential of available open data sources seems to be an encouraging research direction.

Keywords – Toursim ecosystem, GeoAi, Spatial Data Infrastructure, Spatial planning.

Paper type – Academic Research Paper

1 Introduction

Tourism is multifaceted phenomenon that encompasses social, cultural, and economic dimensions. It involves flows of people, often travelling for leisure or business purposes, and it is closely linked to territory by local attractors, transportation system and hospitality services. A key lens for tourism analysis is to investigate the economic dimension of tourism activities in order to identify the financial benefits of tourism services in a specific destination while less remarkable efforts were payed to identify other component of impact of tourism flows on environmental, cultural heritage or other social dimensions (Sharpley, 2002). Indeed, the tourism industry produces synergies with sectors such as cultural heritage, transportation, skills, media, smart communities, and others. The transversality of the tourism industry brings researchers to consider the wider concept of tourism ecosystem as a meaningful term identifying the complexity of the interconnected network of resources and operators that spans across different domains and industries (Andreoli & Silvestri, 2017).

Investigating tourism development, the complexity of this spatial/territorial network is well defined in the literature. However it is possible to affirm that there

is a lack of a solid methodological framework accountable both for researchers and decision makers to measure tourism as a complex phenomena and to improve tourism analytics for better decision making and policy design. Researchers and decision-makers need to be able to trust the framework's output and the data that is used to develop it (Scorza, 2018, 2020). Thus, it is essential to ensure that the framework is built upon sound principles and that the evaluation process is objective, transparent, and trustworthy.

So we analysed the heterogeneity of the tourism industry and its transversality consisting of different services and functions because we reckon that these peculiarities will have a great impact on the territory (R. Gatto et al., 2022a, 2022b).

The tourism sector is multidimensional and multi-stakeholders and has tangible and intangible effects on territorial resources, SMEs values and on people of the place. As a matter of fact, tourism is ascribed with a pivotal role, especially in inland area, for increasing social cohesion, sustaining primary services, maintaining historical and cultural heritage, avoiding depopulation and land abandonment and increasing income. Such general idea that tourism may represents the driver to start an effective process of socio-economic development in inland area is a generalized approach in planning tourism public policies (Scorza & Gatto, 2023) and, very often, it remain an ambition hardly to bring effective benefits or expected results (Las Casas et al., 2018; Las Casas & Scorza, 2016).

In common with other sectors of the economy, it has suffered the shock caused by the pandemic. The COVID-19 crisis has hit the EU economy severely. Its impact varies across territories and enterprise sizes. The crisis also highlighted the interdependence of global value chains and demonstrated the critical role of globally integrated and well-functioning European market. In fact, the pandemic has affected the entire business fabric of the European Union and more so SMEs. There are over 23 million SMEs in the European Union (EU), accounting for 99% of businesses and two out of every three private sector jobs. The data show that 60% of SMEs experienced a decline in turnover in 2020, but a more worrisome finding is that 45% of SMEs planned a significant cut in investments after the pandemic. From these lessons learned from the COVID-19 crisis, the EU has proposed a renewed "New Industrial Strategy" (*European Industrial Strategy*, n.d.) to support investments. This Strategy focuses in particular on Strengthening of the resilience of the EU Single Market improving the functioning of the internal

market. Moreover, the Strategy aims to strengthening the resilience of the EU single market to stimulate trade and competition and to fuel growth and create new opportunities for EU businesses.

The EU single market is organized into 14 industrial ecosystems considered as a drivers of EU economy competitiveness and growth and they encompass all players operating in a value chain: from the smallest start-ups to the largest companies, from academia to research, service providers to suppliers. The industrial ecosystems are organized as follows: construction, digital industries, health, agri-food, renewables, energy intensive industries, transport and automotive, electronics, textile, aerospace and defence, cultural and creative culture industries, tourism, proximity and social economy, and retail. Focusing on tourism ecosystem (R. V. Gatto et al., 2023), this is defined by the network of stakeholders who operate the services of: accommodation, tourism travel operators, hospitality services and transport (Curatella & Scorza, 2020).

This paper highlights in a preliminary discussion on the need to define an accountable platform for monitoring tourism trend in inland area. This research is included in a wider project TechForYou aimed at the implementation of the Innovation Ecosystem promoting and strengthening collaboration through interaction and synergies among the academia and research labs, the production system and territorial institutions in the Calabria and Basilicata Regions.

The proposed approach is oriented to data driven tools referring to Artificial Intelligence and especially GeoAI to analyze in a near real time the huge flow of data end information regarding tourism in a territorial/spatial dimension (W. Li, 2020). We also affirm that tourism as a relational phenomena has to be characterized in a territorial perspective in order to point out the role of the "place" intended as a destination of tourism flows, the system of tourism supply, the "chest" of territorial values to be considered in a sustainable exploitation dimension.

2 "European digital decade" and data driven approach

The "European Digital Decade" is an initiative promoted by the European Union (EU) to promote continent-wide digitization. This initiative aims to improve Europe's competitiveness and ensure that European citizens can fully benefit from the opportunities offered by digital technologies. The initiative is a 10-year plan proposed by the European Commission in March 2021, which aims to improve

the digital transformation of businesses and make Europe a leading global player in the digital economy. The ambition is to establish a vibrant data-driven economy and create a single market for data by ensuring the sharing of European data in key economic sectors, with interoperable and common Data Spaces. Following the European Data Strategy (*Data Act: Measures for a Fair and Innovative Data Economy*, n.d.) the tourism ecosystem will have a single data space with a standard-based structure among all European Countries to enable data sharing among various stakeholders and freely guarantee information flow.

The Digital Decade policy programme sets out four digital ambitions targets. The main goals can be summarised in the following points:

- secure and sustainable data infrastructures;
- digital transformation of SMEs;
- digitalisation of public services;
- a digitally skilled population and highly skilled digital professionals.

Therefore, the plan aims to increase the number of digitally skilled citizens in the EU, improve digital infrastructure such as high-speed internet and international cooperation in digital industry, and encourage SMEs and public services to embrace the most advanced digital technologies such as Artificial Intelligence (AI) (Hastie et al., 2021), data and cloud computing, Internet of Things (IoT) and Blockchain.

Among these ambitious goals, for the purposes of this work, we are firstly interested in the definition of secure and sustainable data infrastructures, through the design of a Spatial Data Infrastructures (SDI) able to manage and harmonize the heterogeneity of data related to the tourism ecosystem. Indeed, we believe that tourism analytics using open data is promising in delivering sensible information and knowledge for improving decision making in tourism development. In particular direct benefits could be addressed to tourism services supply organization, increasing SMEs' earnings, sustainable use of resources and ensuring better living conditions for tourism workers, especially in inland areas, and help policy makers toward effective, context-based (Las Casas & Scorza, 2008; Scorza et al., 2022) and sustainable design (Corrado & Scorza, 2022).

The role of data and information in tourism development planning has been radically transformed by the advent of digital technologies, particularly through the explosion of online platforms and social media. In the rapidly evolving of European tourism industry, which generates massive amounts of data, this is crucial for stakeholders across various sectors: including tourism operators,

private organizations, government institutions and policy makers and also academia to stay in touch with ongoing developments and foresee spatial dynamics (Corrado & Scorza, 2022). Therefore, the challenges in using data for tourism depends on data itself and their heterogeneity(Galasso et al., n.d.). There are many data sources to consider in modelling tourism ecosystem. Based on the literature 4 different types of data sources have been identified (J. Li et al., 2018):

- User-generated data;
- Transaction data;
- Device data;
- Context-specific data.

This initial analysis highlights the volume of data to be managed and the complex relationships between the different sources and types of data and also underline a personal data security issue.

Indeed, recognizing the key role of proper data governance is crucial to ensuring data usability, security, and transparency (Chen et al., 2021). Furthermore, dynamic personal and non-personal data interchange must comply with the European Data Protection Regulation (GDPR) (*Data Protection in the EU*, n.d.) standards and ensure the 7 principles outlined in the regulation: 1) lawfulness, fairness and transparency; 2) purpose limitation; 3) data minimization; 4) accuracy; 5) storage limitation; 6) integrity and confidentiality, security; and 7) accountability. Therefore, accountability in the framework is critical as it ensures that the evaluation process is transparent and that the results obtained are reliable.

The Tourism Satellite Account (TSA) (OECD et al., 2001)is a valuable tool for analyzing the economic impact of tourism. The TSA through a standard statistical framework indicates economic measures of tourism impacts since 2008. This methodological framework, developed by the World Tourism Organization in collaboration with the Statistical Office of the European Communities and the Organization for Economic Cooperation and Development, has prepared the basis for regional-level assessment of the economic impact of tourism. As much as this framework takes into account economic, social and environmental indicators, which are essential components in the assessment of the tourism ecosystem, the concept of territory and spatial dynamics remains marginal.

In order to analyze complex spatial dynamics and their socio-economic impacts on different territories, the most advanced data analysis technologies, such as AI, are needed (Athey, 2017). In particular, Machine Learning (ML) techniques are the

enabling technologies that characterize the emergence of GeoAI as a new interdisciplinary field (Mai et al., 2022)(W. Li, 2020). GeoAI algorithms are well-suited to analyze complex spatial processes and patterns. This techniques are focused on the development and application of AI and ML techniques to geospatial data and could identify complex nonlinear relationships, handle large and complex datasets, and get insight based on complex patterns in the dataset. GeoAI can also be used for multidimensional data visualization, which could help to highlight patterns and statistical relationships that may not be immediately see through traditional statistical techniques.

Data driven approaches and innovative methodological approach for data analytics represents the state of the art of territorial analysis and interpretation. In the perspective of tourism ecosystem as a complex produce of territorial organization: physical functional, social etc.; the discussed technology will be adopted to fulfill the requirements of the research project TechForYou. The new analytics for tourism ecosystem represent a precondition to generate new and more robust knowledge of the running territorial trend. The expectations regard the capacity to detect relevant insights in low demand areas where the scale of macro tourist phenomena are not applyable and different metrics has to be set-up.

Those sensible informative system could be a driver for strategic decision making regarding public investment in tourism or infrastructure balancing the issue of territorial development with the demand for basic services in low density areas. The Case study area of the TechForYou project offers a number of relevant cases characterized by internal areas suffering depopulation and underdevelopment but showing a strong potential in tourism development due to the endowment of natural, Cultural and anthropological resources.

The exploitation of such capital is a complex design problem where the issue of values presentation against over-tourism has a critical role.

3 Conclusions

The connection between the "European Digital Decade" and the tourism ecosystem is therefore important to ensure that tourism can fully benefit from digital technologies and that Europe remains globally competitive.

The focus on tourism ecosystem represents the commitment to manage the complexity of tourism phenomena in a Multidisciplinary and multiscale approach.

The tools derive from the ML and AI and the perspective to exploit the informative potential of available open data sources is an encouraging research direction.

Concerning TechForYou, the research will finalize data infrastructures, analytical techniques in a Spatial Data Infrastructure. AI techniques will be at the bases of the design of a Destination Management System useful to address tourism flows in a more sustainable way.

Tourism sector represents a laboratory field of application and the methodological approaches that will be tested and formalized and next will be transferable on other sector characterizing territorial development planning. Implications regards several territorial planning domains (Pilogallo & Scorza, 2022; Santopietro & Scorza, 2021; Scorza, Pilogallo, et al., 2020; Scorza, Saganeiti, et al., 2020; Scorza & Fortunato, 2021, 2022; Scorza & Santopietro, 2021) directly and indirectly connected with tourism sector.

The potential beneficiaries of the research application will be: Public decision makers, SMEs, local cultural operators and stakeholders and finally the people of place representing the main target of sustainable planning .

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Gender Disclosure in Sustainability Reporting under the Lens of the International Comparative Accounting

Paola Paoloni

Department of Law and Economics of Productive Activities
University of Rome La Sapienza
Via Castro Laurenziano, 9, 00161 Rome

Antonietta Cosentino*

Department of Law and Economics of Productive Activities
University of Rome La Sapienza
Via Castro Laurenziano, 9, 00161 Rome

Marco Venuti

Department of Law and Economics of Productive Activities
University of Rome La Sapienza
Via Castro Laurenziano, 9, 00161 Rome

* *Corresponding author*

Abstract

The Directive 2022/2464 on Corporate Sustainability Reporting (CSRD) amended the Directive 2014/95 on Non-Financial Information (NFID) by introducing changes in gender disclosure. Starting by comparing the texts of two Directives, this paper investigates the factors that influenced the new gender information required. The new Directive devotes specific attention to gender equality information, requiring disclosure on equal pay for equal work, training and skills development, and employment. This is the main innovation introduced by CSRD in accordance with the principle of equal gender treatment that has inspired European legislation (EU, 2020). In this respect, CSRD requirements are consistent with the Pay Transparency Directive, which aims to strengthen the application of the principle of equal pay between men and women and the prohibition of discrimination, though also pay transparency mechanisms. These Directives contribute to the achievement of gender equality and the empowerment of all women worldwide, as envisaged in Goal 5 of Agenda 2030 (UN, 2015).
There have been no major changes in the disclosure of diversity on boards and gender policies adopted and their implementations.

This paper contributes to filling a gap in the studies by highlighting an unexplored area of literature related to the changes in quantity, quality and modalities of regulatory gender disclosure requirements.

Keywords – Gender research, Gender disclosure, Sustainability reporting, Sustainability standardisation, ESRS

Paper type – Academic Research Paper

1 Introduction

Over the last decade, there has been a growing interest by international organisations, national authorities, companies, and researchers in the gender issue. Gender equality is one of the 17 goals (Goal 5) indicated in the 2030 UN Agenda for Sustainable Development (UN, 2015). The aim of Goal 5 is to achieve gender equality and empower all women worldwide. UN (2015) recommend to world nations adopt and strengthen sound policies and enforceable regulations for the promotion of gender equality and the empowerment of all women at every level (Paoloni *et al*., 2023).

In this international context of particular attention to gender issues, various EU legislative initiatives are being raised. One of these is the issuance of the EU Directive 2014/95 on non-financial information (NFID) which requires that specific categories of large European companies provide, among others, information on types of policy used and the results achieved with regard to gender disclosure. The EU Directive implementation required the adoption of guidelines to refer to and how non-financial information is represented. The Guidelines most used by European companies are those published by the GRI (KPMG, 2022).

At the end of 2022, the EU issued Directive 2022/2464 on Corporate Sustainability Reporting that amended, inter alia, Directive 2014/95. The new Directive expands the number of entities required to prepare a sustainability report providing the mandatory adoption of sustainability standards issued by the EU, called the European Sustainability Reporting Standards (ESRS). Corporate Sustainability Reporting Directive (CSRD) aims to improve the flow of information about the sustainability of companies. This directive will make undertakings' sustainability reporting more consistent so that all stakeholders can use comparable and reliable sustainability information.

The replacement of the term non-financial" with "sustainability information" is due to a dissimilar approach to corporate accountability on sustainability issues. Some authors argue this thesis according to whom the change is prompted by a correct interpretation of the materiality principle required by the Non-Financial Reporting Directive (Baumüller and Sopp, 2022; Atanasov, 2022).

This paper aims to analyse the changes in the Directive and the factors influencing this development. From this perspective, we formulate the following research question:

> *What factors influence the different gender disclosure requirements between Directive 2014/95 on non-financial information and Directive 2022/2464 on Corporate Sustainability Reporting?*

To comply with the paper's aim, we examine the quality, quantity and modalities of information presentation related to women comparing, on one side, the NFID requirements and, on the other side, the CSRD. This is a way that permits investigation of the reasons for certain changes in progress. The relevant factors taken into account in the analysis are the following:

- Directive 2022/2381 on improving the gender balance among directors of listed companies and related measures;
- the approval by the EU Parliament of the directive on pay transparency measures directive of the European Parliament and the Council to strengthen the application of the principle of equal pay for equal work or work of equal value between men and women through pay transparency and enforcement mechanisms (EU, 2023). This directive can be called a gender directive;
- the speech of the President of the European Commission to the European Parliament, in which she communicated her intention to simplify the sustainability reporting obligations and reduce them by 25% (von der Leyen, 2023). Sustainability reporting also includes gender disclosure; therefore, it can be assumed that there is an intention at the European level to simplify the ESRS drafts also about gender reporting. This should slow down the publication of the final EFRS by the EU.

2 The process of accounting harmonisation of sustainability reports

Sustainability has become, over the years, a central theme influencing how undertakings operate and communicate with their stakeholders (Epstein *et al.*, 1976; Larrinaga and Bebbington, 2021; Dhaliwal *et al.*, 2014; Gao *et al.*, 2016). This tendency is powerful in Europe, driven on the one hand by the trend of larger companies to prepare sustainability reports (Camilleri, 2015; Adams and Larrinaga, 2019; Amel-Zadeh and Serafeim, 2017) on the other, induced by intense regulatory pressure (European Commission, 2001; 2011; Cosentino and Venuti, 2023).

Information is central to efficient capital allocations; therefore, investors' demand for sustainability reporting has grown tremendously.

Scholars draw a distinction between two main paths for developing sustainability accounting. Critical theorists argue that corporate accounting is not fit to record and disclose information about corporate social and environmental impacts (Gray and Bebbington, 2000; Gray, 2002; Gray, 2010). However, through awareness raising, this critical approach contributes to developing sustainability accounting and reporting. Another path, the managerial one, views sustainability accounting as "the provider of solutions to problems and directs attention to tools which can support decisions to be made in a set of diverse circumstances by diverse actors, different types of managers as well as different stakeholders" (Burritt and Schaltegger, 2010:842).

The logical conclusion is that both paths must be followed if sustainability is to become anything more than an exercise in awareness-raising and problem-solving. Thus, sustainability accounting and reporting development should be more geared, on the one hand, towards improving management decision-making, on the other hand, to the convergence process towards standardising the sustainability accountability report.

However, the convergence process towards standardising the sustainability accountability report is still far from being completed for various reasons.

Firstly, many overlapping and slightly different sustainability concepts exist, such as corporate social responsibility and ESG (environment, social and governance) (Stolowy and Paugam, 2023; Berg *et al.,* 2022; Gillan *et al.*, 2021). At the same time, there is disagreement about its measurement and coexist different sustainability reporting: integrated reporting, sustainability reporting and non-financial reporting (Kimbrough *et al.* 2022).

The different views of sustainability and the distinct forms of measurement and reporting also depend on the coexistence of various international organisations engaged in sustainability reporting or the promotion of sustainable activities, such as the Global Reporting Initiative (GRI) and the Sustainability Accounting Standard Board (SASB, recently absorbed by the ISSB) which are among the international organisations that enjoy a high level of legitimacy and claim sovereignty over corporate sustainability reporting.

Further aspects that hinder the homogenisation of sustainability standards lie in the different relevance states give to the issue.

Some jurisdictions, such as the EU, require undertakings to disclose information about several dimensions of sustainability, whereas other states follow a voluntary sustainability disclosure approach (Giner, 2022). Furthermore, in some countries, mandatory sustainability-related disclosures are required for specific sectors (e.g. extraction industries in the USA) (De Lange and Howieson, 2006) or particular sustainable activities (e.g. corporate philanthropy activities in the UK or India) but not in other fields (Darendeli *et al.*, 2022). Lastly, certain countries allow firms to choose among several frameworks (e.g. GRI, SASB), even for mandatory sustainability reports.

3 Research methodology

To comply with the paper's aim, we compare the legal provisions of two Directives (NFID vs CSRD). The method of comparison, appropriately adapted, is usually applied in studies of international comparative accounting and the evolution of standards (Nobes and Parker, 2010; Gebhardt, 2000; Van der Tas, 1988).

The specific purpose of this line of study often leads to considerations concerning the convergence process of accounting standards and the factors determining it (Van der Tas, 1988). In other words, this approach permits focusing on the various elements of rupture with respect to the past discipline and highlights the various innovative elements (Baldini, 2023).

This paper adopts the comparative approach between regulatory sets to identify the change that has occurred in the accounting rules and then carry out considerations on the ongoing evolutionary process and the factors that determine it. To this purpose, the paper examines the quality, quantity and modalities of information presentation related to women comparing, on one side,

the NFID requirements and, on the other side, the CSRD requirements. This is a way that permits investigation of the reasons for certain changes in progress.

The standards adopted by companies to implement the provisions of these directives are not examined in this phase of the research. The standards are essentially GRI in the case of NFID and draft ESRS in the case of CRSD. To date, the ESRS are still being defined.

The analysis carried out is of a qualitative nature under a double aspect: i) considering the type of analysis performed (content analysis of Directives paragraphs) and ii) due to the fact that the CSRD will enter into force starting in 2024.

For the purposes of the research, the requests in terms of gender disclosure of the Directives are first compared, initially examining the recitals and then the articles of the two Directives.

The analysis is carried out by identifying homogeneous clusters on a conceptual level on which to highlight any existing differences and the reasons for these differences.

4 Results and Discussion

4.1. Comparison of Directives requirements

Tables 1 and 2 contain the comparison between NFID and CSRD as regards gender requirements. Table 1 compares the text of two Directives' recitals while Table 2 compares the text of their articles. Bold fonts are not present in the original texts of the Directives analysed and were added by the paper's authors to emphasise gender requirements. Thus, identifying the parts specifically referring to gender issues can be considered a first result of the research. The numbers next to the texts shown in Tables 1 and 2 indicate, respectively, the paragraph number of the recital and the article number from which the texts were extracted.

Table 1- Comparison of gender disclosure in the Directives recitals

Directive 2014/95 (NFID)	**Directive 2022/2426 (CSRD)**
(7) As regards social and employee-related matters, the information provided in the statement may concern the **actions taken to ensure gender equality**	(49) Sustainability reporting standards should specify the information that undertakings should disclose on social factors, including working conditions, social partner involvement, collective bargaining, **equality, non-discrimination, diversity and inclusion, and human rights.** Sustainability reporting standards that address social factors should specify the information that undertakings should disclose with regard to the principles of the European Pillar of Social Rights that are relevant to businesses, including **equal opportunities for all and working conditions.** … Sustainability reporting standards that address **gender equality** and equal pay for work of equal value should specify, amongst other things, **information to be reported about the gender pay gap**, taking account of other relevant Union law
(18) **Diversity** of competences and views of the **members of administrative, management and supervisory bodies** of undertakings facilitates a good understanding of the business organisation and affairs of the undertaking concerned. It enables members of those bodies to constructively challenge the management decisions and to be more open to innovative ideas, addressing the similarity of views of members, also known as the 'group-think' phenomenon. It contributes thus to effective oversight of the management and to successful governance of the undertaking. It is therefore important to enhance transparency regarding the diversity policy applied. This would inform the market of corporate governance practices and thus put indirect pressure on undertakings to have more **diversified boards** (19) **The obligation to disclose diversity policies in relation to the administrative, management and supervisory bodies with regard to aspects such as, for instance**, age, **gender** or educational and professional backgrounds should apply only to certain large undertakings. Disclosure of the diversity policy should be part of the corporate governance statement, as laid down by Article 20 of Directive 2013/34/EU. If no diversity policy is applied there should not be any obligation to	(3) … **diversity on company boards** might have an influence on decision-making, corporate governance and resilience. (49) Sustainability reporting standards that **address diversity should specify, amongst other things, information to be reported on gender diversity at top management and the number of members of the under-represented sex on their boards**

put one in place, but the corporate governance statement should include a clear explanation as to why this is the case	
	(58) In order to progress towards a more gender-balanced participation in economic decision-making, it is necessary to ensure that undertakings whose securities are admitted to trading on a regulated market in the Union always **report on their gender diversity policies and the implementation thereof**

Source: Authors' elaboration on the basis of NFID and CSRD

By comparing the recitals of the two Directives, three conceptual clusters emerge which can be likened: i) gender equality; ii) diversity in the boards; iii) gender policies and implementation thereof.

The first cluster concerns the actions taken by companies to ensure gender equality. In the NFID the issue is only stated as a general principle, without providing application details. In the CRSD, on the other hand, the topic is dealt with in several aspects, recalling the main components. Reference is made to relevant elements such as non-discrimination, equal opportunities and the gender pay gap. The general concept is therefore declined in more specific application concepts and, as such, with less blurred contours. This is a clear step towards goal 5 and, therefore, towards achieving effective gender equality at the European level.

The demand for this disclosure is in line with the provisions of the pay transparency directive which aims to strengthen the application of the principle of equal pay for equal work or work of equal value between men and women ('principle of equal pay') and the prohibition of discrimination, though also pay transparency mechanisms. The new legislation will require EU companies to disclose information that makes it easier for employees to compare salaries and expose existing gender pay gaps. In addition, the Directive fixed dissuasive penalties, including fines, for employers that do not comply with the rules and established companies will have to act if their gender pay gap is over 5%.

The directive aims to make wages more transparent by obliging companies with more than 100 employees to report and correct their pay inequalities, in a bid to reduce the gender pay gap in the EU, which currently stands at 13%. Thus, CSRD and Equal Pay Directive are two mutually coordinated regulations both aimed at using disclosure requirements as a pressure tool for companies to strive to eliminate the gender gap.

The second cluster concerns the issue of diversity in company boards. There are no substantial differences between the recitals of the two directives regarding the information on the composition of the boards. From this point of view, the simultaneous publication of Directive 2022/2381 on the gender balance among directors of listed companies does not seem to have had any impact. This probably derives from the fact that the proposal of the directive on gender quotas on boards dates back to 2012 and therefore had already had the opportunity to influence the information requests contained in the NFID. In this respect, there is a continuity of disclosure requirements between the NFID and the CSRD.

The third cluster we have identified concerns the CSRD's statement only of a general principle according to which "it is necessary to ensure that undertakings whose securities are admitted to trading on a regulated market in the Union always report on their gender diversity policies and the implementation thereof." Nevertheless, the recital refers to a type of information present in the articles not only of the CSRD but also of the NFID. Thus, it is not a new concept compared to the previous directive, but rather the underlying importance of required information.

Table 2 - Comparison of gender disclosure in the Directives articles

Directive 2014/95	**Directive 2022/2426**
	Article 19b) … (2) The sustainability reporting standards … shall require that the information to be reported is understandable, relevant, representative, verifiable, comparable, and is represented in a faithful manner The sustainability reporting standards shall, taking into account the subject matter of a particular standard: … (b) specify the information that undertakings are to disclose about social factors, including information about: (i) **equal opportunities for all, including gender equality and equal pay for equal work, training and skills** development, and employment and inclusion of people with disabilities;
Article 20 (1) (g) **a description of the diversity policy applied in relation to the undertaking's**	Article 20 (1) g) **a description of the diversity policy applied in relation to the undertaking's**

administrative, management and supervisory bodies with regard to aspects such as, for instance, age, **gender**, or educational and professional backgrounds, **the objectives of that diversity policy, how it has been implemented and the results** in the reporting period. If no such policy is applied, the statement shall contain an explanation as to why this is the case.';	**administrative, management and supervisory bodies with regard to gender** and other aspects such as, age, or educational and professional backgrounds, **the objectives of that diversity policy, how it has been implemented and the results in the reporting period**. If no such policy is applied, the statement shall contain an explanation as to why this is the case.

Source: Authors' elaboration on the basis of NFID and CSRD

The same three conceptual clusters examined concerning the recitals are present in the articles of the two Directives.

Regarding the first cluster, it should be noted that, in line with the recitals, the CSRD requires that the standards provide detailed information on equal treatment and gender equality in its various profiles: equal pay for equal work, training and skills development, and employment. This information is complementary to the provisions of the pay transparency directive that require member states to establish gender pay gap reporting in which workers and workers' representatives will have the right to receive clear and complete information on individual and average pay levels, broken down by gender. Both directives fall within the logic of Equal gender treatment legislation, thus in terms of reduction and, in perspective, elimination of the currently existing gender gap.

The World Economic Forum (WEF, 2021) specifies that worldwide no state has filled the existing gender gap. Regarding the second cluster, there are no differences between the predictions of the NFID and the CSRD. Both require a description of the diversity policy applied concerning the company's administrative, management and supervisory bodies.

Even in the case of the third cluster, no differences are found.

Although the provisions are the same in the case of the last two clusters, it does not mean there will be changes in the reporting between companies.

These differences may arise at the level of implementing standards of the two directives. Thus, the three clusters examined should be further investigated with regard to the provisions contained in the GRI (the standard commonly adopted by European companies in terms of non-financial reporting; KPMG 2022) and in the ESRS. By comparing the provisions of these standards, it will be possible to obtain more detailed evidence of the expected evolution in terms of information on gender and the factors behind this evolution. A subsequent study of this first analysis carried out in this paper will be dedicated to this.

5 Conclusion

This research analyses the evolution of gender disclosure requirements in sustainability reporting according to European Directives, investigating the determinants of those changes. European Directives compared are NFID, currently in force, and CSRD which will enter force in 2024.

The methodological research used in this work is descriptive. It was carried out by highlighting the differences that emerged by comparing the old legislation and the novelties of the new one.

We grouped the disclosure requirements into the following three clusters: i) gender equality; ii) diversity in the boards; iii) gender policies and implementation thereof.

With regard to gender equality information, we found a significant increase in disclosure requirements in CSRD, in accordance with the principle of equal gender treatment that inspired the European legislation (EC, 2020). In this respect, CSRD requirements are consistent with the pay transparency directive, which aims to strengthen the application of the principle of equal pay between men and women and the prohibition of discrimination, though also pay transparency mechanisms. Both Directives contribute to the achievement of gender equality and empowering all women worldwide, as provided by goal 5 of the UN Agenda 2030 (Paoloni *et al.*, 2023; UN, 2015).

No changes were introduced in disclosure on diversity in the boards, presumably considering that the information required in the NFID took into account the political orientation already present in the proposal of the Directive on improving the gender balance among Directors of listed companies issued in 2012 converted only recently in Directive 2022/2381.

Substantially identical is the disclosure required on gender policies and their implementation. The only difference between the two directives is that the CSRD emphasises the importance of that information in the Directive recital.

This paper makes several contributions to gender literature.

First, this paper fills a gap in the studies by highlighting an unexplored area of literature related to the changes in quantity, quality and modalities of regulatory gender disclosure requirements.

Second, to the best of our knowledge, this is the first research exploring the factors influencing different gender disclosure requirements between NFID and CSRD.

This research has some limitations. It is preliminary research and offers some insights into changes in European sustainability reporting requirements. To reach more analytical conclusions, it is necessary to extend the analysis by comparing standards adopted on the basis of the two European Directives. However, the draft ESRS published in 2022 immediately raised controversy over the excess of information and the associated onerous compliance costs (Venuti, 2023). Currently, draft ESRS are under review given the political intention to reduce sustainability reporting requirements by 25 per cent (von der Leyen, 2023) and any assessment on them may have an element of uncertainty.

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Gender Diversity Management in a Decade of Research: A Structured Literature Review

Paola Paoloni

La Sapienza University of Rome
Via del Castro Laurenziano, 9
00161 Rome (IT)

Antonietta Cosentino

La Sapienza University of Rome
Via del Castro Laurenziano, 9
00161 Rome (IT)

Martina Manzo*

Roma Tre University
Via Silvio D'Amico, 77
00145 Rome (IT)

** Corresponding author*

Abstract

If "diversity" can be defined as the distribution of attributes among interdependent members of a work unit (Jackson et al., 2003), "diversity management" (DM) can be recognised as the comprehensive process of building an environment where all the employees can interact effectively through practice and organisational structure aimed to manage the diversity (Yadav and Rajak, 2022; Roberson et al., 2017; Pitts, 2006).
This process consists of implementing measures that make an organisation's workforce more diverse and inclusive, promoting genuine communication and transmission of knowledge (Trittin and Schoeneborn, 2017; Fältholm and Norberg, 2017).
Among the most evident aspects of social diversity is gender diversity, which always kept women in a background position compared to men, both in the public and private sector (Fusco et al., 2022; Dong, 2022).
The measures and actions aimed at achieving equal representation of men and women represent Gender DM (GDM) (Kamasak et al., 2020; Uddin and Manir Chowdhury, 2015).
The present research aims to i) analyse how economic literature is facing GDM); ii) classify the main foci of analysis in the extant literature; iii) identify thriving future research areas.
The analysis is conducted through a Structured Literature Review (SLR) methodology (Paoloni and Demartini, 2016), a literature classification widely used in business studies to classify them according to four lenses: Article Focus, Research Area, Geographic area;

Research method. The present work considers 153 studies among articles, conference papers, book chapters and books identified on the SCOPUS database by searching "diversity management" and "gender". The authors considered only the studies that have been published in the last ten years.
This paper implements gender studies about women's emancipation in employment and improves studies about diversity management by adopting a gender perspective. It categorises all the studies related to Gender and Diversity Management (GDM) to give researchers a better understanding of the challenges and opportunities women face in the workforce, and the measures organisations take to address these issues.

Keywords – sustainability, gender gap, women, gender equality, diversity management

Paper type – Academic Research Paper

1 Introduction

The journey to Diversity Management (DM) began in the 1960s and has transversally concerned the social, legal and economic spheres of the United States, first and Europe and other countries later (McCrea *et al*., 2022; Roberson *et al*., 2017; Buemi *et al*., 2015).

When the American nation cast a new light on the concept of equality, as the intention to progressively erase all forms of diversity so that everyone could enjoy access to social rights and citizenship, institutions began to implement politics based on Affirmative Actions (AA)[1] (Roberson et al., 2017; Reddy and Parumasur, 2014; Anderson, 2004). However, scholars interested in inequality in workplaces for various reasons soon began to question the effectiveness of AA, noting that it was often consumed in isolated and circumscribed interventions in human resources (Ince, 2023; Booysen et al., 2016). Since the 1980s, anti-discrimination practices have been reworked based on a new concept: "Diversity Management" (Foley, 1994; Berne, 1994). Among the most evident aspects of social diversity, there is gender diversity, which always kept women in a background position compared to men, both in the public and private sector (Fusco et al., 2022; Dong, 2022). The set of measures and actions aimed at achieving equal representation of men and women represents Gender DM (GDM) (Kamasak et al., 2020; Atena and Tiron-Tudor, 2019; Uddin and Manir Chowdhury, 2015).

[1] *AA are interventions that aim to eradicate discriminatory practices through the implementation of strategies to incorporate previously disadvantaged groups into all aspects of community life and to remove obstacles that hinder the realisation of equal opportunities in the employment and social sphere (Topić et al., 2020; Benslimane and Moustaghfir, 2020).*

The present work examines the evolution of research about DM, with a specific focus on policies aimed at managing and reducing gender inequalities. Recently, literature about this topic has increased in line with socio-cultural evolution. With the aim of comprehending how literature about this topic has developed and how it could be further deepened, the present paper proposes a Structure Literature Review (SLR). Thus, the present research aims at answering the following research questions (RQs):

RQ1. How is literature developing the topic of GDM?

RQ2. What are the main foci of analysis in the extant literature?

RQ3. What are the possible future research areas?

The analysis uses the SLR methodology (Paoloni and Demartini, 2016), classifying scientific papers on GDM according to Article focus; Research area; Geographic area; Research methodology.

The next paragraph describes the SLR methodology, providing a presentation of the taxonomy used. The results obtained and the general trends identified are illustrated in the third paragraph replying to RQ1. Finally, in the fourth paragraph, answers to RQ2 and RQ3 are exposed.

2 Methodology

To overview the last decade's economic literature concerning GDM, the authors resorted to an SLR (Serenko, 2021; Paoloni and Demartini, 2016), a more and more popular methodology in business studies (Rocco et al., 2023; Dal Mas et al., 2023). SLR requires a rigid protocol based on its validity (Petticrew and Roberts, 2008) and reliability (Yin, 2009) and a strict description of how the process happened. The pathway that the authors carried out is deepened in the following paragraphs.

2.1 The sample selection

To answer the RQs, the authors extracted the results from the SCOPUS database, considered the most comprehensive database (Del Vecchio et al., 2022; Paoloni and Manzo, 2022). Since using the words "gender diversity management" only twenty-four documents resulted, the authors used the keywords "diversity management" and "gender", limiting the research to "Title, Abstract, Keywords," to prevent documents unrelated to the object from being extracted (Paoloni et al., 2020b). Hence, the starting string was TITLE-ABS-KEY ("diversity management"

AND "gender"). The research was carried out on 14 February 2023, and 331 studies resulted, but the sample was further reduced by imposing additional filters. As for the type of documents, only articles, books, book chapters, and conference proceedings (Paoloni et al., 2020b) were considered (namely 296 of the original set). In addition, to overcome linguistic problems (Mauro et al., 2017), the authors selected only the papers in English and Italian (287). Furthermore, as the SLR wanted to maintain an economic perspective, the authors focused on two research areas: Business, Management and Accounting; and Economics, Econometrics and Finance (201 results). Finally, being a subject that in the most recent years has attracted the attention of institutions, policymakers, and scholars, to comprehend the most recent studies better, a period was imposed, considering only the studies published between 2013 and 2023 (153). Figure 1 shows the sample selection process (Paoloni and Manzo, 2022; Paoloni et al., 2020a).

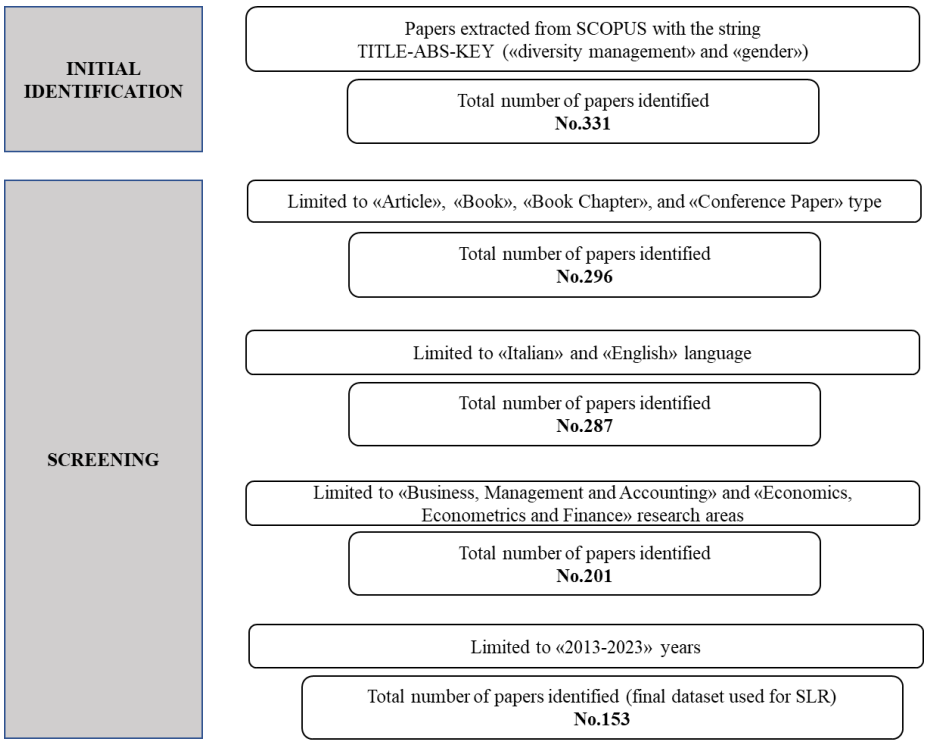

Figure 1 – The sample selection process
Source: Authors

2.2 The analysis framework elaboration

As previously mentioned, SLR requires the application of a valid framework. The present study uses the one Paoloni and Demartini (2016) introduced and classifies the papers according to four lenses: Article Focus (A), Research Area (B), Geographical Location (C), and Research Method (D). Basing on the sample extracted, the authors elaborated a framework appropriately declined according to this research's needs. It is represented in the figure 2.

A. Topic	**B. Research area**	**C. Geographical area**	**D. Research methods**
1 - Public sector	1 - Business, Management and Accounting	1- Middle East	1- Literature review
2 - Corporate	2 - Economics, Econometrics and Finance	2- South and Central America	2- Qualitative
3 - Non-Profit		3- North America	3- Quantitative
4 - Generic organisation		4- North Europe	4- Mixed methods
5 - Other		5- South Europe	
		6- Asia	
		7- Africa	
		8- UK	
		9- Oceania	
		10- Comparative	

Figure 2 - Analytical framework
Source: Authors

A. Article focus

The main topics faced in the extant economic literature concerning GDM are split into five categories, according to the application scope of the GDM policies analysed.

- A1. Public sector. This class involves studies focused on GDM policies applied in the public sector.
- A2. Corporate. The second cluster gathers all the studies facing gender inequalities in private corporations, operating in different fields (hospitality, banking, mining, manufacturing, and IT).
- A3. Non-Profit. This rank counts the studies analysing the GDM policies elaboration and application in Non-profit organisations.
- A4. Generic Organization. Literature involved in this class reports GDM policies analysed by adopting a generic perspective and without applying them in a specific context.
- A5. Other. This residual class includes studies that the author does not attribute to the categories mentioned above as dealing with topics that are not treated enough to constitute an independent category or not strictly relevant to the research topic, therefore difficult to contextualise.

B. Research area

The current SLR focus on the economical literature; hence only two research areas are involved. The papers are attributed to one or the other research area from the database SCOPUS.

C. Geographical Area

This variable indicates the geographical area that is investigated by the authors. To focus only on the essence of the research topic, we have not considered the researcher's country of origin but the area of interest in the research itself (Paoloni and Demartini, 2016).

D. Research Methods

This classification can show how specific research methods change based on different years, countries, and research topics. D4 involves research that applies both qualitative and quantitative methodologies.

3 Findings

3.1 Article focus

The analysis only considers the works published in the last ten years, from 2013 to 2023. Figure 3 shows the relevance of article focus on the sample.

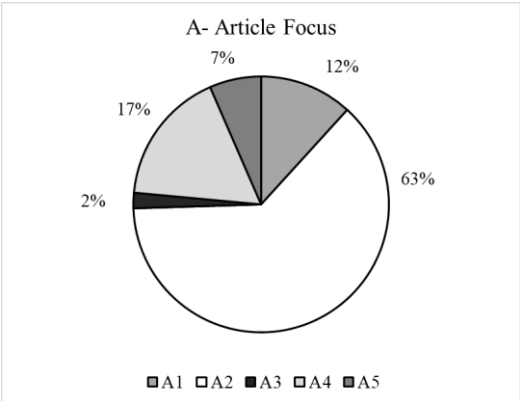

Figure3 – Article focus
Source: Authors

The broadest category gathers papers about GDM policies adopted in Corporates (A2), representing 63% of the sample (96 papers). The second broadest category is A4, investigating GDM policies theoretically or adopting a generic perspective. This cluster represents 17% of the sample (26). Finally, the article focus A1, gathering the studies concerning the public sector, which represents 12% of the sample (18). As for the "other" cluster, A5, involves 7% of the documents (10). Finally, research facing GDM policies in Non-Profit Organizations (NPO) only constitutes 2% (3) of all the works.

3.2 Research Area

Figure 4 shows in which research area the extracted studies are mainly placed.

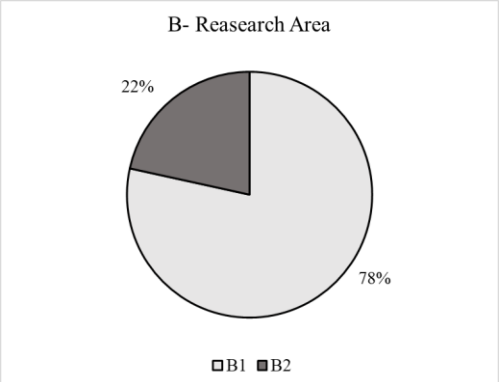

Figure 4 – Research Area
Source: Authors

The largest category is Business, Management and Accounting (B1), representing 78% (120 papers) of the total sample. The cluster Economics, Econometrics and Finance (B2) counts the residual 22% (10).

3.3 Geographic Area

Figure 5 shows the distribution of studies focused on different geographical areas.

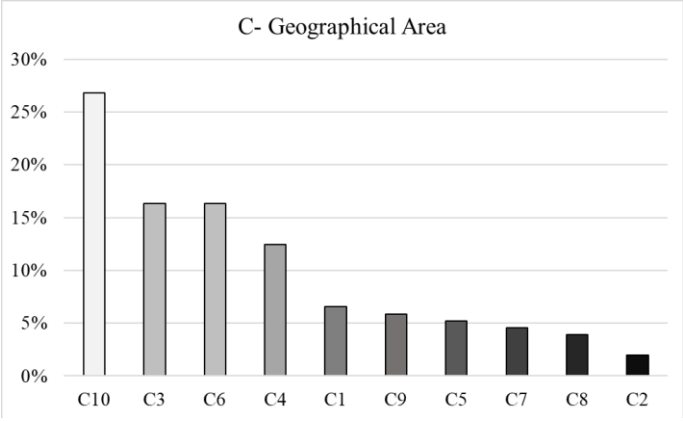

Figure 5 – Geographical Area
Source: Authors

As shown in Figure 5, there is an apparent disparity between the geographical areas analysed by GDM scholars. The most significant number of studies

proposes a comparative study among two or more countries (C10), covering 27% (41) of the total. As for the research interested in one specific area, C3 and C6 contain the same number of documents involving the studies, respectively, focused on North America and Asia. Each of them occupies 16% (25) of the sample. After them, North Europa (C4) is the most analysed geographic area composing 12% (19) of the sample.

Except for C2, the gap among the other categories consists only of one document; indeed, C1 constitutes 7% (10) of the total, C9 represents 6% (9); C5 and C7 count both 5% with respectively 8 and 7 studies, and C8 represents 4% (6). Finally, C2 is the least analysed geographical area, South and Central America, counting only 3 studies and representing 2% of the sample.

3.4 Research Method

Figure 6 shows the distribution of the different research methods in the sample.

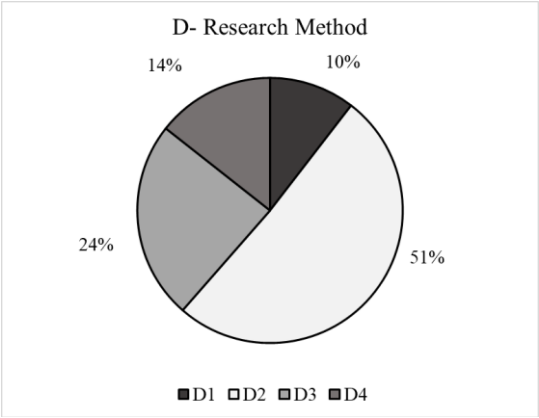

Figure 6 –Research Method
Source: Authors

The primary methodology is qualitative research (D2), used in 51% of the contributions (78), followed by the quantitative method (D3), applied in 24% of the studies (37). Research using mixed methodologies (D4) represents 14% (22), and literature reviews (D1) constitute a residual 10% (16).

3.5 The most cited articles

The articles were also analysed based on how often they have been quoted in other research (Ardito *et al*., 2015).

Years\Article focus	A1	A2	A3	A4	A5	Σ
2013	111	28			15	154
2014	1	208		27		236
2015		103		20		123
2016		186		40	9	235
2017	1	162		16		179
2018		21				21
2019	23	33		14	6	76
2020	19	149			8	176
2021	45	35		34		114
2022	5	12	3	4		24
2023						
Σ	**205**	**937**	**3**	**155**	**38**	**1338**
	15,3%	**70,0%**	**0,2%**	**11,6%**	**2,8%**	**100**

Figure 7 – The most cited articles
Source: Authors

The analysis reveals that studies investigating GDM policies implemented by corporates (A2) are the most quoted research (70%). It is interesting noticing that until 2013 research focused on the gender gap in workplaces was mainly focused on Public Sector (A1); since 2014 private companies have earned more and more relevance among the GDM scholars representing every year the most quoted field. A1 occupy 15,3% of all the studies cited in the literature, namely the second most-quoted cluster. Research quoting A4 are 11,6%, with a peak of maximum citation in 2016. The residual category involving "other" studies (A5) has been quoted for 2,8%, and A3 only records 0,2% of quotations, all in 2020.

4 Discussion

4.1 The main foci of analysis in the extant literature (RQ2)

The authors want to identify the themes explored in the present literature review.

A1. Promoting and protecting diversity and inclusion in public organisations is essential to pursue social equity (Hoang et al., 2022). Gender equity requires a fair

separation of labour, rights, obligations and responsibilities between men and women, encouraging a fair organisational culture (Benslimane and Moustaghfir, 2020). The works involved in this cluster adopt a double perspective. Most of them consider gender diversity in boards, highlighting how inclusive leadership can create commitment, higher performance, and sustainability (Ince, 2023; Mitra et al., 2021; Nelson et al., 2021). Other studies consider gender diversity among employees, focusing on how gender may affect their perception of organisational inclusion (Mousa et al., 2021; Blouch et al., 2019).

The main sectors analysed in public organisations are academic (Mousa et al., 2021; Wieczorek-Szymańska, 2020; Asirvatham and Humphries, 2019; Nentwich and Sander, 2015) and healthcare (Blouch et al., 2019).

A2. Part of the literature about GDM in corporate organisations faces gender discrimination phenomena, such as the gender pay gap (Zhu et al., 2022) or the glass ceiling (Atena and Tiron-Tudor, 2019). Most of them focus on board gender diversity, which appears to be considered a relevant variable when replacing directors; indeed, female directors are more likely to replace females (Dodd et al., 2022). Some studies document a positive relationship between board gender diversity and firm performance (Raddant and Takahashi, 2022; Farag and Mallin, 2017), whereas other research focus on the positive link between board diversity and CSR performance, as it promotes information elaboration and improves the ability of the company to recognise stakeholders needs (Firoozi and Keddie, 2021; Harjoto et al., 2019). The sector mainly analysed are hospitality (García-Rodríguez et al., 2020; Madera, 2018), banking (Agbontaen, 2019), mining (Sasikala and Sankaranarayanan, 2022; Fältholm and Norberg, 2017), manufacturing, (Mansoor et al., 2021; Hennekam et al., 2019) and IT (Shanmugam, 2017; Kundu and Mor, 2017).

A3. Studies about GDM in NPO are only three, and all were published between 2022 and 2023; hence it seems reasonable to define it as an emerging topic. Shohaieb et al. (2022) focus on the relationship between board diversity and CSR disclosure, concluding that in NPO the DM disclosure level is very low and positively affected by the board size, women's presence, and board independence.

A4. Some studies that concern GDM without specific contextualisation focus on analysing the link between the implementation of GDM policies and firm performance (Mehng et al., 2019; Balanagalakshmi and Kumari, 2019). Other studies focus on gender discrimination, also considering sexual orientation

discrimination (Paniza and Moresco, 2022; Hildebrandt, 2018). The perception of employees is a sub-topic present also in this cluster. Balanagalakshmi and Kumari (2019) affirm that generally, employees consider women incapable of assuming leadership roles because they do not dispose of some characteristics that are essential to be a leader, like emotional stability, temperament, self-reliance, competitiveness, self-confidence, ambition and exhaustive information of the current affairs and happenings.

A5. This cluster involves some studies that are not perfectly inherent to GDM, but that emerged from the SCOPUS research because they concern related or similar themes. For instance, there is a paper focused on the dynamic effect of demographic dissimilarity on absenteeism behaviour (Reinwald and Kunze, 2020), or research on major outcomes from global employability surveys about gender diversity (Mutovkina et al., 2016).

4.2 Future research areas (RQ3).

To answer the RQ3, in light of the analysis carried out, we wondered what trends still needed to be deepened. Certainly, the analysis of GDM in NPO companies turns out to be a topic worthy of insights because only three studies have focused on the topic, highlighting different aspects, thus without exhausting a line of research that delved into a particular aspect.

Another issue worth exploring appears to be the GDM disclosure, namely the analysis of the methodologies, organisational processes and tools through which organisations choose to communicate the policies to reduce the gender gap. In the resulting sample, only one research focuses on CSR disclosure (Shohaieb et al., 2022). Currently, the most widely used tool for communicating policies and initiatives implemented by organisations to bridge the gender gap is gender budgeting, introduced in public organisations by the Directive of 23 May 2007 of the Department of Public Administration of the Presidency of the Council of Ministers. In addition, one of the first definitions of gender budgeting was provided by the European Parliament Resolution of 3 July 2003, developed by the European Commission 2002/2198, which refers to the theory of gender budget analysis and envisages the achievement of four objectives: equity, transparency, efficiency, and awareness.

On the other hand, private corporates have recently begun to dedicate a section of their sustainability report to diversity and inclusion, communicating the

policies applied to pursue gender equality. Nevertheless, they rarely decide to elaborate an independent report on gender equality. For this reason, it appears extremely interesting and relevant to analyse how gender budgeting or new tools can be adapted to a private organisation.

5 Conclusions

This article contributes to the literature in several ways. Firstly, it enriches the literature about diversity management, offering an analysis of research that has interested this topic in the last ten years. Secondly, adopting a gender perspective, this paper implements gender studies about women's valorisation and emancipation in workplaces, considering both the public sector and corporate. Finally, it classifies all the studies focused on GDM, allowing the researchers to have a clearer view of women's difficulties and opportunities in employment and how organisations try to overcome them.

On the one hand, the study summarises the trends of previous research in terms of the topics covered, the methodologies considered most suitable, the countries and the research area that mainly analyse female entrepreneurship. Finding reveal that most of the studies analyse GDM in private corporations, that they mainly belong to Business, Management and Accounting, that they primarily compare the policies applied in different countries and that the most used research method is qualitative methodology.

On the other hand, the present work facilitates the identification of literary gaps that can be filled by future research. The authors consider it necessary to identify which article focus and sub-topic needed to be explored. Findings reveal that it is worthwhile for new research to delve deeper into how NPOs try to overcome the gender gap. An interesting topic that involves all the article focus would be the relationship between GDM and CSR disclosure.

The central limit of the research is identified in the sample phase; indeed, findings are limited to that resulting from the database used (SCOPUS); it is unlikely that significant variation in results would occur if a different database were used. Secondly, the coding process could be improved. Although it was carried out systematically with care to ensure consistency in each component, there may be errors of omission and coding. Finally, adding the variable: 'other' in classifying some categories may have hidden some exciting results.

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Increasing Social Sustainability in Agricultural Sector for Supporting Resilience: A First Preliminary Analysis

Federica De Leo

Department of Economic science
University of Salento
Campus Ecotekne via per Monteroni 73100, lecce, Italy

Valerio Elia, Maria Grazia Gnoni, Fabiana Tornese*

Department of Innovation Engineering
University of Salento
Campus Ecotekne via per Monteroni 73100, lecce, Italy

Diego De Merich, Armando Guglielmi, Mauro Pellicci

Department of Medicine, Epidemiology, Occupational & Environmental Hygiene, Italian National Institute for Insurance against Accidents at Work (INAIL), Italy
Via Roberto Ferruzzi, 40 - 00143 Roma

* *Corresponding author*

Abstract

The scientific debate about sustainability in agricultural sector is growing worldwide, thanks to the increasing awareness of customers towards the impact of their consumption behaviors. While a great deal of attention is given to the economic and environmental dimensions of sustainability, social sustainability is more easily left out of the analysis of agrifood supply chains. In particular, research on occupational health and safety (OHS) in agrifood is not vast, although the sector is among the most critical ones for what concerns accidents on the workplace. As an example, agriculture and food industry workers are considered high-risk groups during the handling of equipment, chemicals, and cleaning of contaminated instruments because they are exposed to health hazards that require an effective training program along with personal protective equipment. Similarly, the fishing industry has been identified as an exceptionally precarious occupation compared to other industries due to its high rate of accidents and deaths. This work is a first attempt to fill this gap: starting from the analysis of open data available through a national database

provided by the Italian National Institute for the Insurance of Work-Related Injuries (INAIL), a critical analysis of work-related injuries and near miss events in Italian agrifood companies is provided. A discussion on the results is presented proposing some evidence-driven guidelines and research gaps, with the aim of shedding light on OHS in the Italian agrifood sector, its main criticalities, and possible directions.

Keywords – social sustainability, safety data, injury analysis, prevention

Paper type – Academic Research Paper

1 Introduction

Evaluating Social Sustainability issues in the agricultural sector is a very complex issue as it equally emphasizes environmental, economic, and quality of life goals (Hayati et al., 2011). Over the years, most sustainable agriculture research has focused primarily on environmental stewardship and profitability, although agriculture ranks among the most hazardous industries. By analysing the social dimension of sustainability, one focus point is connected to health and safety of workers. Thus, data at national and international levels outlined that agricultural workers are at very high risk for fatal and nonfatal injuries (Hard, 2002; HSE, 2022; NIOSH, 2023). Agricultural injuries and illnesses are higher than many other industries, and information about these events can help in the development, implementation, and translation of prevention programs and policies. However, in some nations, there is a lack of structured information mainly due to the absence of a national surveillance system: it has to be noted that surveillance is a critical component of effective prevention and intervention, thus contributing to increase the overall resilience level of the agricultural sector. Similarly, current analyses about applying resilience in the agricultural sector mainly focus on environmental issues (e.g., climate change), almost neglecting influences due to social issues (Urruty et al., 2016).

The study proposes a quantitative analysis about the current state of safety levels of the agricultural sector in Italy based on occurred injury analysis collected from the national surveillance system. The paper is organized as follows: section 2 reports a state of the art analysis about injuries occurred in the agricultural sector, while section 3 proposes a quantitative analysis about Italian data aiming to point out most critical activities as well as risk factors affecting the agricultural sector at national level. Conclusions are summarized in section 4.

2 A literature review analysis

Several recent and past studies have analysed safety data in the agricultural sector from different perspectives and methods. Some studies analysed current literature to highlight some critical issues. Jadhav et al. (2016) proposed a meta-analysis of current literature in order to point out emerging risk factors for agricultural injuries. Several factors were outlined ranging from organizational, technical to social ones. Kumar et al. (2000) analysed literature about injuries related to agricultural equipment, outlining most relevant suggestions essentially as preventive measures to be adopted during their use.

Different approaches are based on analysing structured data available at national/local level. Thus, the presence of a national surveillance system where structured data is collected could contribute to reduce the complexity of this task, and at the same time, guarantee more accuracy. This is confirmed by the study developed by Earle-Richardson et al. (2011), who proposed a quantitative analysis based on three different main data sources to evaluate feasible solutions for designing a national surveillance system in the US agricultural sector. Data originated primarily from ambulance reports, hospital discharge, and county safety officials. Even if the cross analysis had provided interesting feedbacks about most frequent causes of injuries: authors also outlined how a more integrated safety data system is essential to design an effective national surveillance system. With similar targets, Murphy et al. (2019) proposed and validated a specific classification methodology for data about injury, illness, and disease associated with agricultural hazards. Thanks to national data availability, Lovelock et al. (2007) proposed a detailed comparison about injury data in the agricultural sector collected in different areas in the world, from North America, Europe, and Australasia. Patel et al (2010) discussed injury data collected in a specific Indian region for farmer workers outlining safety of agricultural equipment as one of the most critical issues to be solved.

When national structured data are not available, one useful tool is a survey analysis developed on a specific sample. Westaby and Lee (2003) proposed a survey analysis for pointing out antecedents of injury among a specific cluster in the US agricultural sector: young people working in agricultural settings. Obtained results outlined strong relationships (e.g. between safety activities and safety consciousness) as well as more complex ones. Chae et al. (2014) discussed a survey analysis developed regarding the Korean farmers sector to estimate the

national agricultural injury rate and for identifying most relevant factors associated with these injuries. Mishra and Satapathy (2018) described results obtained from a survey analysis aiming to evaluate the impact of hand tool injuries in agricultural farmers in a specific area in India.

Differently from these studies, Pfortmüller et al. (2013) proposed a quantitative analysis for assessing injury severity in the Switzerland agricultural sector based on data derived by admissions to a specific emergency department.

Other studies analysed specific hazards and/or hazard sources. The impact of heat on occupational injuries in the agricultural sector is analysed in different ways. Spector et al. (2016) discussed, through a cross analysis between injury data and historical meteorological ones, the potential relationship between heat exposure and traumatic injuries in outdoor agricultural workers. Di Blasi et al. (2023) discussed effects and impacts of by using data extracted from national databases. Another study about a specific disease (Kidney damage) in a sample of California agricultural workers was proposed by Moyce et al. (2020): the analysis was carried out trough wearable systems, and next, cross analysis was developed in order to point out more critical parameters of both working activities and workers health. Wibowo and Soni (2016) proposed a field analysis about potential hazards related to the use of specific agricultural equipment (i.e., hand tools) adopted by farmers in Indonesia: obtained feedbacks have been provided to redesign tools in a safer way.

3 An analysis of Italian safety data of agricultural supply chain

In Italy, official data on injuries at work is collected by INAIL, the National Insurance Institute against Accidents at Work (Campo et al., 2020). Thus, a quantitative analysis has been carried out on this database (Inail, Statistical Database, 2023), available online, over a five-year period, i.e., between 2017 and 2021. The first target is to evaluate the accident trend of agricultural sector compared to others in order to evaluate its overall level of hazard. In Table 1 the comparison between the time trend of accidents occurred in the agricultural sector versus accidents recorded in all other industrial sectors is reported. Based on this data, the agricultural sector is contributing to the overall value with an average value about 7%.

Table 1. Accident trends analysed during the period 2017 to 2021

	Year					
Sector	***2017***	***2018***	***2019***	***2020***	***2021***	**Total**
Agricultural	27,465	26,699	25,936	20,649	20,607	***121,356***
Other industrial sectors	338,967	333,582	330,722	354,679	306,053	***1,664,003***
Total	**366,432**	**360,281**	**356,658**	**375,328**	**326,660**	**1,785,359**

Another interesting result is that 2017 and 2021 the accidents included in agriculture decreased by about 25%, which is a greater reduction than accidents in all other sectors, which is about 10%: this is also outlined by Figure 1.

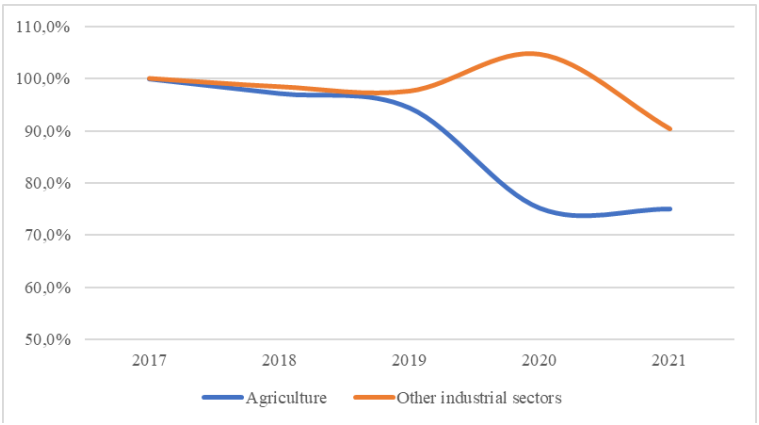

Figure 1 – Trends (expressed in %) in occurred accident at work in agricultural and other industrial sectors in the analysed period.

It should be emphasised that the peak observed in 2020 for all industrial sectors appears to be connected to Covid-19 diffusion, which had had less impact on agriculture due to its intrinsic dynamic of diffusion.

Next, an analysis on data about fatal accidents occurred in the analysed period has been developed. The total number of fatal accidents varies from 89 in 2017 to 91 in 2021, recording an increase of 2.2%: it has to be noted that also this value is lower than ones recorded for all industrial sectors, i.e., an increase of 5.5%.

Thanks to structured data in the INAIL database (Inail, Statistical Database 2023), a more detailed analysis about most frequent hazardous systems has been carried out. In detail, total number of accidents involving or not means of

transport in the agricultural are reported in Table 2. Data shows that at least 5.5% of accidents in agriculture involve a means of transport.

Table. 2 - Patterns of accident occurrence in agriculture for the period 2017 - 2021

	Year					
Accident in agriculture	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
With means of transport	1,341	1,418	1,480	1,163	1,324	***6,726***
Without any means of transport	26,124	25,281	24,456	19,486	19,283	***114,630***
Total	**27,465**	**26,699**	**25,936**	**20,649**	**20,607**	**121,356**

It has to be noted that although in the analysed period accidents involving means of transport essentially remains stable over time, they represent approximately 40% of fatal accidents recognized by INAIL. Thus, as vehicles - such as tractors, earth moving machines, tillers, etc. – are adopted in several working phases (tilling the land, mowing the grass, treatment with plant protection products, fertilizing, sowing) they usually represent one of the main accident hazard in the agricultural sector.

In order to analyse with more detail causes of fatal injuries in the Italian agriculture sector, a specific database has been used: Infor.Mo (from "Infortuni mortali", work-related fatalities in Italian) the open access database of the Italian national surveillance system for occupational fatal injuries (Campo et al., 2020) which provides quantitative data about occurred fatal injuries together with their determinants. Infor.Mo system has been developed by INAIL in cooperation with Regions and Autonomous Provinces, and Local Health & Safety Departments (LHSDs), which are the centres of administrative operations related to public healthcare in Italy under the National Healthcare Service. The database is based on information derived from fatal injuries investigations conducted by LHSDs after each event.

In detail, the injury dynamic is analysed based on a backward path, usually applied in the judicial investigative process; next, a multi-factorial model is developed in order to point put root causes of occurred fatal injury (De Merich et al., 2022). Starting from the last event in chronological order (i.e. the biological damage), the multi-factorial model identifies the accident that occurred (e.g. a fall from a height of the worker or the overturning of a work vehicle) and the related causes (i.e. risk factors) of the injury, grouped by six major categories: (i) *activity of*

injured person, (ii) activity of another person present in the injury dynamics, (iii) equipment, machines, plants, tools, (iv) materials, (v) working environment conditions, (vi) personal protective equipment (PPE).

By analysing data in Infor.Mo from 2017 to 2021 (Inail Infor.Mo Database, 2023), 234 fatal injuries in the agricultural sector were selected; a total value of 465 risk factors were associated to these events. Summary data about the specific type of accident extracted from the database are reported in Table 3.

Table 3. Types of accident occurred for fatal injuries in the agriculture sector extracted from Infor.Mo in the analysed period (2017 to 2021).

Type of accident occurred	**Total occurrence**	**Percentage**
Vehicles exiting their route (overturning)	109	46,6
Fall of workers from height	24	10,3
Contact with moving vehicles or objects in their usual location	22	9,4
Unexpected starting of vehicle, machine, equipment	21	9,0
Fall of heavy bodies onto workers	14	6,0
Contact with moving parts of equipment	11	4,7
Other type of accidents not classified (N<10)	33	14,1
Total	***234***	***100,0***

The analysis of the specific accident dynamic outlines the clear prevalence of accidents due to loss of control while driving the work vehicle, which often led to the vehicle overturning. The data shows that the equipment most involved are tractors, with or without trailer. The second most frequent type of accident is falling from height, which occurs from equipment where work is taking place at height (e.g. portable ladders) or from working environments at height. These are the most hazardous activities based on historical data analysis.

Next, the analysis has focused on pointing out the risk factors that have caused these events: data are in Table 4. Information have been clustered aiming to outline the contributions of accidents that occurred from vehicles exiting their route (overturning) towards other accidents.

Table 4. Categories of risk factors for fatal injuries extracted from Infor.Mo in the analysed period (2017 to 2021).

Risk factor categories	**Total fatal injuries**	**Accidents involving only overturning [%]**	**Other accidents [%]**
	Occurrence *		
Activity of injured person	267 (57.4%)	61.3	53.3
Equipment, machines, plants, tools	99 (21.3%)	26.1	16,3
Working environment conditions	39 (8.4 %)	5.9	11,0
Activity of another person	31 (6.7%)	2.9	10.6
Personal protective equipment (PPE)	15 (3.2 %)	2.5	4,0
Materials	14 (3.0%)	1.3	4,8
Total	***465 (100.0%)***	***100.0***	***100,0***
*In parenthesis percentage values are reported			

Data outline the most critical risk factors in the occurred fatal injuries: the highest value is due to the specific activity developed by the worker, but a high contribution is also due to interaction with equipment. By overlapping data about vehicles loss of control, these two categories increase their criticality. Furthermore, for other types of accidents, two different categories - Working environment conditions and Activity of another person (e.g. other workers present in the accident scene) - have a greater weight compared to the total fatal injuries sample.

For *fatal accidents due to vehicles overturning*, in almost all cases the loss of control is connected to manoeuvring errors while driving the vehicles (88%). In about 75% of the data set, overturning occurs due to two concomitant factors: manoeuvring errors are often associated with structural deficiencies in the work equipment, mainly the absence of driver's seat protection systems and driver retention. This is a relevant information as the hazard could be reduced by substituting old equipment with safer ones.

In addition, driving errors are mostly due to underestimating the characteristics of the environment (e.g., the slope of the land, the presence of unevenness close to the work area, the stability of the land) where the workers operated; another issue to be considered is the procedure adopted for driving the vehicles on the road during the transfer phases from/to the workplace, which is usually a high source of hazard.

For *fatal injuries due to a fall of workers from height*, the analysis of the causal factors highlights a lack of or inadequate risk assessment activity. In maintenance activities, procedural errors of access/parking in the place at height are often accompanied by deficient structural characteristics of the same (roof capacity, absence of provisional works to protect against the risk of falling from a height such as walking surfaces and parapets, etc.) and failure to use the necessary PPE to work safety.

4 Conclusions

The study proposes a critical analysis about injuries occurred in the Italian agricultural sector in order to outline most hazardous activities and risk factors in this sector. The purpose is to analyse the social dimension of this sector aiming also to support the design of most effective prevention activities. The study aims to overcome a gap still present in the literature about the assessment of social sustainability in the agricultural sector, which is mainly focused on labour organization. Further developments could be oriented to evaluate how accident prevention could quantitatively contribute also to increase the resilience level of the agricultural sector towards interruptions due to accidents at workplace.

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Corporate Museum in Agrifood Sector: Implementing Ba for Knowledge Creation

Walter Vesperi*

Magna Græcia University of Catanzaro
Campus Universitario "S. Ventura" loc. Germaneto (CZ)

Concetta Lucia Cristofaro

E-Campus University

Anna Maria Melina

Magna Græcia University of Catanzaro
Campus Universitario "S. Ventura" loc. Germaneto (CZ)

Marzia Ventura

Magna Græcia University of Catanzaro
Campus Universitario "S. Ventura" loc. Germaneto (CZ)

* *Corresponding author*

Abstract

The agri-food context represents a very complex and dynamic sector, which influenced by the current competitive ecosystem, is experimenting with new way to enhance and implement knowledge. The characteristics of the agri-food organizations impose the need to rethink the "traditional" knowledge management practices (Bresciani, 2017; et al., 2018; Vesperi and Coppolino, 2023). Indeed, even in the agri-food sector, corporate museums are proliferating, with the aim to collect, archive and enhance knowledge, currently considered obsolete and not used within the agri-food organization. In this way, the corporate museum represents a "container" of knowledge (or organizational memory); that is, a space shared between various actors that through interaction, observation and experience between them, collaborate to start a process of co-creation of new knowledge (Durst and Zieba, 2019; Baima, et al, 2020, Vesperi and Ingrassia, 2021). The strategic role of the corporate museum emerges for the agri-food organization as Ba, in other words an ideal shared place for the creation of new individual or organizational knowledge (Nonaka 1994; and Konno, 1998; Del Giudice, et al., 2013). The aim of this study is to analyze the strategic role of the corporate museum, in the agri-food sector, in facilitating the creation

of new knowledge. In particular, the corporate museum is considered as a place shared by various actors to implement a process of co-creation of knowledge.
This study is based on a qualitative methodology of an exploratory nature. The complexity of the phenomenon has imposed the need to use a multi-step methodology (Bowen, 2009; Yin, 2009). The first step of the analysis, using the Museimprese database (museimpresa.com), made it possible to develop descriptive indicators in order to understand the diffusion and characteristics of corporate museums in Italy and the connection with the agri-food sector.
A case study was analyzed in order to better understand the main aspects related to the creation of knowledge and the corporate museum. The results suggest the growing importance of the strategic role that the corporate museum plays in the agri-food sector; in fact, it allows to valorise "obsolete" knowledge and through a process of co-creation to generate new knowledge. In fact, the main innovative element of this study consists in the theoretical perspective used to analyze corporate museums in the agri-food sector.
The practical implications of this study can suggest entrepreneurs and the management of agri-food organizations to implement new solutions for the creation of knowledge, through the corporate museum.

Keywords – Agrifood, Knowledge Creation, Corporate Museum, Ba, Italy

Paper type – Academic Research Paper

1 Introduction

The agri-food sector represents a strategic sector for national (or local) economic systems. For this reason, it has always been at the centre of attention of policy makers and scholars. In fact, the evolutions and innovations of the agri-food sector have a direct consequence on the wealth and well-being of a community. In this competitive context, like the current one, agri-food companies must base their competitive advantage on the valorisation and transfer of knowledge. Some sectors have shown a greater propensity to value and implement knowledge in their internal processes. In fact, a current of studies shows this propensity of some sectors such as the automotive (Canonico, et al., 2021) or in public administrations (Wiig, 2002; Syed - Ikhsan and Rowland, 2004; Massaro, et al., 2015). Some entrepreneurial forms have also proved to be particularly inclined to valorise knowledge such as start-ups (Myers, 2009), spin-offs (Antonelli, 2004; Vesperi & Gagnidze, 2019). At the same time, the agri-food sector is considered as a sector with a low propensity for innovation and R&D. For these reasons, the agri-food sector and agri-food organizations represent a new challenge for KM scholars.

Indeed, the agri-food sector is represented by micro and small agri-food organizations (Ménard & Klein, 2004; James, et al., 2011) with a low propensity for innovation and low investments in R&D and characterized by low knowledge.

The characteristics of the agri-food sector have generated unique and specific knowledge management practices (KMPs). In fact, to enhance traditional knowledge (Ragavan, 2001) and the history of business, agri-food organizations have created corporate museums. Corporate museums are the subject of great attention from scholars, involving a plurality of disciplinary fields. There are still few studies dealing with corporate museums connected to agri-food organizations, making use of theoretical frameworks based on organizational theory, and in particular linking corporate museums to knowledge transfer and organizational memory. Studies on corporate museums have focused on the perspective of marketing (Piatkowska, 2014; Carù, et al., 2017) and corporate branding (Iannone, 2020) others in the more recent perspective of corporate culture (Nissley & Casey, 2002; Felipe, et al., 2017).

This study aims to offer some initial reflections to fill this gap in the literature. This study - in the context of organizational theory studies - analyzes the strategic role of the corporate museum as a form of organizational memory and heritage capable of transferring knowledge. To achieve this, a qualitative descriptive methodology based on the analysis of secondary sources is used. We present the rest of this work as follows: after this (i) introduction, (ii) the main theoretical elements on the Corporate Museum, Organizational Memory and agri-food organizations are discussed. In the following (iii) the methodological process is illustrated. Finally, (iv) the main conclusions and suggestions for future research.

2 Theoretical Framework

2.1 Corporate Museum and organizational memory

The corporate museum is a phenomenon relatively recent in management and organization studies. In fact, the phenomenon appears in recent years. In general, the first corporate museums appear in the United States at the beginning of the 20th century (Danilov, 1992). Afterward, the first corporate museums arose in other countries, such as Great Britain (1906), Germany (1911) and Italy (last twenty years of the 20th century). The first corporate museums assume a historical character, i.e. corporate spaces dedicated to the collection and exhibition of

company documents, photographs and historic production machines, or they tried to reconstruct the history of the company or the contribution of the founder and other managers to the its growth. Alongside these dedicated corporate spaces, factory visits assume the same function (Axelrod & Brumberg, 1997; Mitchell & Orwig, 2002; Lin, 2020). The main purpose of the first corporate museums is to "collect" the artifacts of the company (Iannone and De Chiara, 2019; Martinez, 2020). Some authors do not identify this configuration as a corporate museum, but as a corporate collection (Nissley & Casey, 2002; Booth & Rowlinson, 2006). The corporate collection has no strategic value but represents a simple collection of organizational artifacts. In this way the corporate museum assumes a strategic value. Corporate museums are tools capable of sharing and transmitting the knowledge and values created within an organization, through the representation of organizational memory. The representation and narrative of organizational memory allows the organization to improve the dialogue with its external and internal stakeholders (Sandberg & Tsoukas, 2020). Several authors have proposed classifications of corporate museums. For example, Amari (2001) creates a classification based on museum ownership (public or private, single or multi-company ownership). Few studies have investigated the phenomenon of corporate museums using the theoretical frameworks of an organizational theory, based on the constructs of organizational memory and knowledge transfer. This study explores corporate museums as a form of organizational memory and, when used strategically, as a tool to transfer knowledge from the organization to the stakeholders. The concept of organizational memory assumes different conceptions in the academic literature. An interesting line of studies focuses on the definition of organizational memory as a repository (Huber, 1991; Grant, 1996; Alavi & Leidner; 2001; Antunes & Pinheiro, 2020; Zahra, et al., 2020). According to this line of studies, organizational memory represents a set of knowledge present within an organization in the form of documents, information material or any other form that can facilitate internal activities and be easily accessible. In this perspective, the artifact takes on a particular meaning. The corporate museum represents a form of organizational memory that must be used consciously and strategically. Corporate museums allow for the transfer of routine knowledge and practices through the narration of organizational culture and memory.

Organizational culture has distinctive and enduring characteristics and is part of organizational memory. The organizational culture is linked to the nature and success of the company and constitutes the starting point on which external

relations and decision-making processes are based. Some of the elements that characterize the organizational culture are codified and shared in the formal documents of the organization (such as official company deeds, strategic plans, internal communications, disciplinary procedures). These documents become organizational artefacts, often displayed and used in corporate museums. These artifacts make one organization instantly distinguishable from another organization. Organizational culture also affects the way individuals work within the organization.

2.2 The role of Ba in the knowledge co-creation process

In the process of creating new knowledge, it is necessary to identify the context or environment (Nonaka & Takeuchi, 1995; Volpato, 1995; Nonaka & Kono, 1998; Zardini, 2012, page 28). According to this theoretical assumption, "space" (or place) influences KMPs. It is not possible to manage the knowledge creation process without a specific environment (Casey, 1999; Nonaka et al., 2000). Starting from the studies of the philosopher Kitaro Nishida, Nonaka & Konno (1998) define with the Japanese word "Ba" the ideal environment for the creation of knowledge.

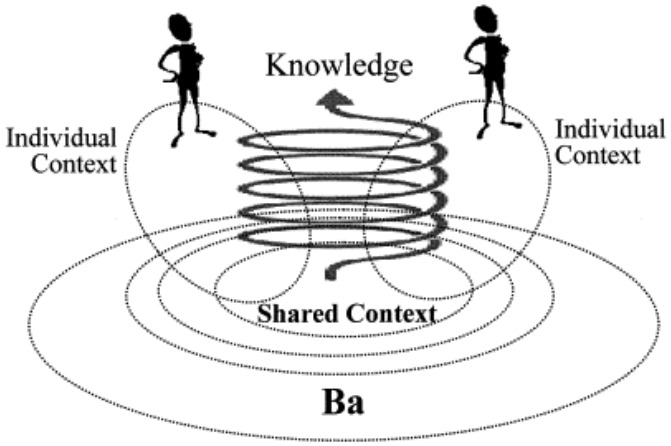

Figure 1 – "Ba" as a shared and dynamic environment
Source: Nonaka et al., 2000; pag. 14

The term "Ba" can be translated as a place or a shared space essential for the creation of knowledge. Nonaka and Konno (1998), analysing the concept of Ba, define it as a place, real or virtual, capable of creating new knowledge through human interactions.

The Ba assumes that knowledge possessed by an individual can be transferred and increased, within this space shared with other individuals, through the interaction, observation or experience of the other participants. The Ba can therefore be defined as a place where information is interpreted and integrated with the knowledge present in a limited place and time existing in the organization to become new usable knowledge (Wenger, 1998; Nonaka, et al., 2000).

Combining the SECI model it is possible to identify four different types of Ba: *originating*, *dialoguing*, *exercising* and *systemising*. Each type of Ba supports a particular knowledge conversion process.

Originating Ba is created through the sharing of a physical space (face-to-face) and an individual relational one. Through originating Ba an individual encounters another individual by sympathizing and empathizing, sharing emotions, experiences and mental models. This Ba represents the socialization phase of the SECI model. Tacit knowledge and individual organizational issues, through socialization, are transferred and shared to generate new knowledge and new organizational solutions. The second type of Ba is *dialoguing Ba*. The creation of this Ba, unlike the originating Ba, is more conscious. In fact, while originating Ba is generated almost spontaneously, the assumption underlying the construction of dialoguing Ba is the selection of specific knowledge and skills for a project team, a task force or a cross-functional team. In the SECI model, it represents the outsourcing process. Through dialogue, members of dialoguing Ba share their mental models and skills which are converted into common concepts and models. Dialogue is the key tool for such conversions, making extensive use of metaphors and elements of organizational culture for the creation of meaning and value for the whole organization.

The Ba that develops in the virtual space as a place of interaction are based on the use of online networks, group-ware, documentation and databases. The *virtual Ba*, therefore, represent a virtual platform for the exchange of data, information and knowledge. Like dialoguing and originating Ba, they can be determined by an individual or collective interaction. *Exercising Ba* is based on an individual interaction in a virtual space. In the SECI model it represents the internalization phase. This type of Ba places the emphasis on the continuous learning of the subject, who autonomously manages his own training program, through the consultation of databases and information systems of the organization. *Exercising Ba* facilitates the conversion of explicit knowledge into

tacit knowledge. Individual knowledge is continuously increased using formal (explicit) knowledge through simulated applications. Systeming Ba is based on a collective interaction using a virtual space. In the latter, the growing use of new technologies within organizations has allowed more effective support in the combination of explicit knowledge, creating virtual collaborative environments.

In conclusion, the Ba must be seen as an important element in the organizational planning of modern organizations as it allows individuals to interpret the information and data present in the organization, generating new knowledge and consequently expanding the knowledge base on which the organization can base its strategy and competitive advantage. Precisely for this reason, the organizational analysis effort of the Ba must be oriented towards defining an organic and dynamic place for the knowledge creation process.

3 Methodology

The study aims to understand the phenomenon of corporate museums in Italy active in the agri-food sector. According to the protocols and indications suggested by Yin (2013), we adopted a qualitative and descriptive approach based on a case study (Eisenhardt, 1989; Yin, 1994, 2013; Ventura, et al., 2020). A qualitative nature seemed particularly coherent with the purpose of the research and for the complexity of the phenomenon since it allows us to take into account the specific characteristics of the public organizational context (Bamberger, 2000). This approach involved collecting data using a variety of sources, including semi-structured interviews and internal documents (Canonico, et al., 2020).

Privileged access to relevant information has allowed authors to collect data from different sources, increasing the quality of the information obtained" (Benbasat, 1984; Zardini et al., 2016, p.67).

A case study has been observed in this research because it is particularly favorable when taking an inductive approach and using theory to explain empirical observations. The complexity of the analysis required the need to divide the methodological process into two phases.

In the first phase of the methodological process, the main theories on the transfer of knowledge and organizational memory were compared to frame the phenomenon of corporate museums.

The second step - on the job - was the identification of corporate museums in Italy. This phase was carried out by analyzing those present in the public and free

dataset created by Museimpresa. Museimpresa is an Italian association, its aim is to promote the valorisation of company archives and corporate museums. Data has been observed up to 04/10/2022 (mm/dd/yy0yy). The dataset shows 101 corporate museums in Italy. The observed case study has allowed us to better understand the strategic role of the corporate museum.

4 Main results and discussion

The data and information contained in the database were processed through descriptive statistics indicators. From the analysis of the database, it is possible to understand the diffusion of the phenomenon in Italy.

The first preliminary result is the geographic distribution of corporate museums in Italy.

The Figure 2 shows the geographical distribution is not homogeneous. In fact, Lombardy is the region with the highest concentration of corporate museums. Lombardy was among the first Italian regions to experience the industrial revolution. The regions with the highest concentration of corporate museums are the regions with a widespread and consolidated industrial and entrepreneurial fabric. The Valle d'Aosta, Sardinia and Molise regions do not have corporate museums. The other regions have at least one corporate museum.

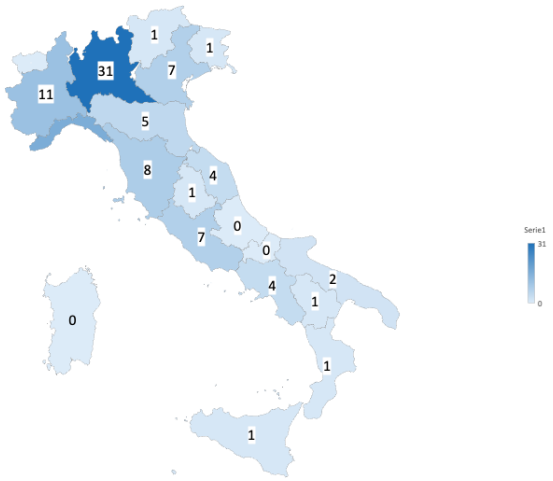

Figure 2. Geographical distribution of Corporate Museum in Italy
Source: own elaboration

From the analysis of the Museimpresa dataset, it emerges that over a third of company museums in Italy are connected to the agri-food sector. The massive presence of corporate museums linked to the agri-food sector highlights the economic impact of the sector.

The next step is to understand the strategic value of corporate museums in the agri-food sector. To achieve this result, two variables have been related: size (micro/macro) and strategic value.

The Figure 3 allows corporate museums to be classified according to the strategic value they provide to the parent organisation. The second dimension is based on the breadth of organizational artifacts collected in the corporate museum.

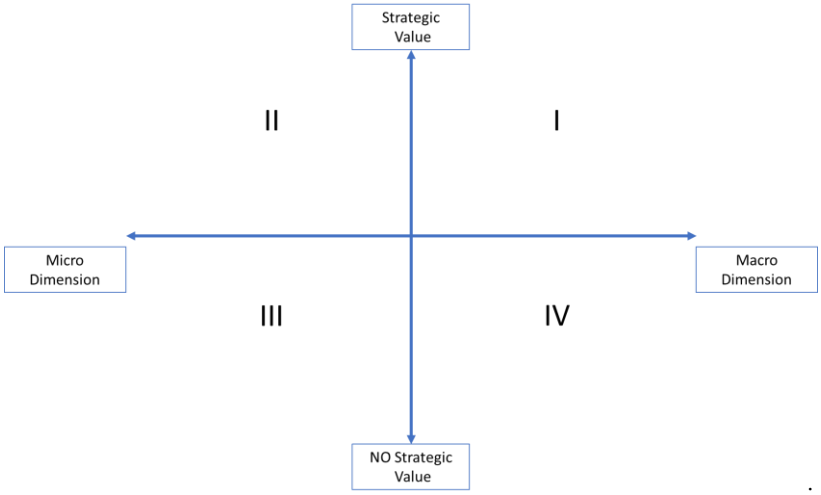

Figure 3. Framework on Corporate Museum
Source: Own Elaboration

The growing strategic importance of the corporate museum emerges from the analysis of corporate documentation and the collection of information, to enhance knowledge and create value for the reference community. In fact, the central role of the corporate museum emerges in generating new knowledge. The corporate museum becomes a place in which to bring together different knowledge and above all to make different stakeholders interact. Thus, a dynamic process of co-creation of knowledge is generated, based on the knowledge present in the museum.

5 Conclusions

The growing attention of policy makers and scholars on the agrifood sector has generated a copious and vast literature. Corporate museums in the agri-food sector seem to have been overlooked in this debate. This study aims to offer initial reflections on corporate museums in the agri-food sector, from the point of view of organizational memory and the transfer of knowledge.

The identification of the corporate museum as a "Ba" assumes that the corporate museum assumes a strategic value in the transfer of knowledge and above all a fundamental role in the process of co-creation of knowledge. There are several actors who enter into this process of co-creation of knowledge (employees, suppliers, management, customers and above all the community).

The introduction of new innovations (or knowledge) in agri-food organizations has a direct and positive impact on the level of well-being. For this reason, the direct involvement of the reference community.

Furthermore, agribusiness organizations, through enterprise museums, have demonstrated their ability to design KMPS.

This study is not without limitations. In fact, the main limitation of this study is represented by the dataset. The dataset analysed does not include all corporate museums in Italy. Registration is voluntary, so some corporate museums may not be registered. Furthermore, since the aim of the study was to offer an overview of the phenomenon and for convenience, a clear distinction was not made between corporate museums, historical archives and hybrid forms. Despite these limitations, the results of this study offer interesting insights for the development of future studies on the topic. A gap emerges in the literature on corporate museums, from the point of view of knowledge transfer and organizational memory.

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New Work in Public Administration: Translating Workplace and Organizational Requirements into Spatial Patterns. A Methodological Approach

Anja Jannack*

Wissensarchitektur – Laboratory of Knowledge Architecture
TU Dresden
Zellescher Weg 17, 01069 Dresden

Solveig Hausmann

CIMTT Zentrum für Produktionstechnik und Organisation
TU Dresden,
Helmholtzstr. 7, 01069 Dresden

Jörg Rainer Noennig

Wissensarchitektur – Laboratory of Knowledge Architecture
TU Dresden
Zellescher Weg 17, 01069 Dresden

Martin Schmauder

CIMTT Zentrum für Produktionstechnik und Organisation
TU Dresden,
Helmholtzstr. 7, 01069 Dresden

* *Corresponding author*

Abstract

Digitalised work processes, fast information flows and flexible project structures also have an impact on the design of working environments and work organisation. Hybrid work and multi-structure offices are concepts that are often implemented in the private sector but rarely in the public sector. Due to the pandemic conditions of the last two years, however, many employees and employers in the public sector have gained experience with remote work in home offices.

The "paperless office" is increasingly becoming reality, filing cabinets are getting smaller and replaced by e-files. Digital screen work, video conferencing as well as extensive data and document exchange via cloud services increasingly determine everyday work. It can be questioned whether spatial-organizational formats such as the conventional two-person

office are still appropriate solutions for office work in the future public sector. Are there new (spatial) environments that create more suitable work conditions for the changing requirements? How can employees participate in the design of these new work environments? How can they be empowered to re-organise and re-use their work environment under the changing conditions?
This paper reflects on a feasibility study conducted by TU Dresden for a large Saxon administration. Addressing "Future Work" scenarios, it focused on new concepts for workplace design, work organisation and knowledge management. The feasibility study started with a survey of employees in order to derive spatial, organisational and technological requirements for new work organization and spatial concepts.
The paper introduces – besides the scientific and practice background – the overall procedure of the study as well as new concepts for work organisation and workplace design. On the one hand, it focuses on (online) surveys and co-design workshops as methodological approaches for the assessment of needs. On the other hand it discusses the specific results of the feasibility study. It concludes with the translation of the findings into schematic designs, and outlines how to incorporate the insights in the future planning of new work organization and spatial concepts in public administration.

Keywords – Design Science, Co-Design, User driven needs assessment, Office planning, Design-Pattern, Digital Knowledge Management

Paper type – Academic Research Paper

1 Introduction

The "paperless office" is increasingly becoming reality, file cabinets are getting smaller and replaced by e-files. Digital screen work, video conferencing as well as extensive data and document exchange via cloud services increasingly determine everyday work. It can be questioned whether spatial-organizational formats such as the conventional two-person office are still appropriate solutions for office work in the future public sector. This paper reflects on an a feasibility study conducted by the TU Dresden at a large Saxon administration in terms of "Future Work" focusing on new concepts for workplace design, work organisation and knowledge management.

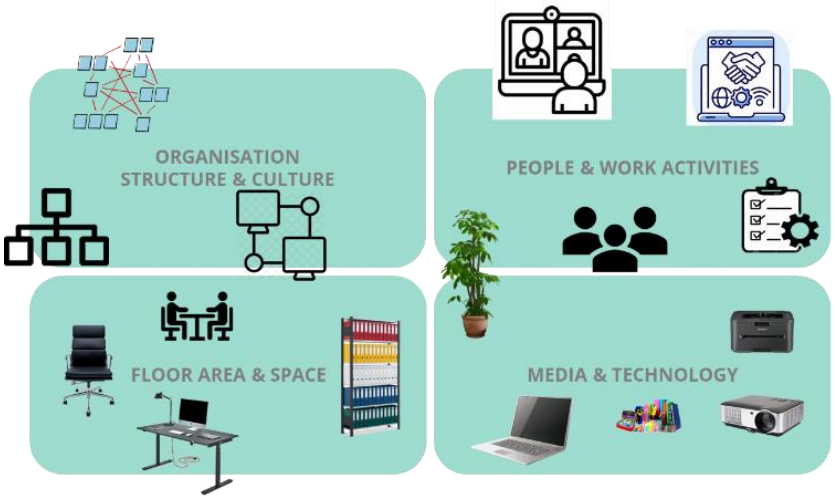

Figure 1: Design dimensions of work organisation and workplace design (Source: Wissensarchitektur TU Dresden)

Digitalisation and hybrid work are current developments becoming more and more widespread in connected work environments (so-called "Arbeitswelt 4.0"). Organisations and companies are required to rethink the structure of their work organisation and office space design. More flexibility is needed in the face of swift changes, such as the pandemic-induced adaptations during the past years. Four design dimensions – as introduced in the feasibility study – must be taken into consideration: **Organisation Structure & Culture**, **People and Work Activity**, **Floor area and Space**, as well as **Media and Technology** (Figure 1).

More flexibility in regards to working hours and to the place where work activities are carried out results in changed office workspaces, especially their design. Since the COVID-19 pandemic, office and knowledge workers have started to more frequently use their homes as places to work. This leads to temporary spatial overcapacities in office buildings that may be used otherwise in the future.

Employee work processes are heterogeneous and vary within a broad spectrum. There are activities that need to be carried out in quiet and in concentrated manner. On the other hand, there are multiple coordination activities, meetings, consultations and exchanges necessary. A suitable orientation is provided by the activity-based workplace concept (Marzban et.al. 2022, Appel-Meulenbroek et.al. 2011), which divides office space into different zones fitting best for the respective work and communication activity.

When introducing new concepts for work organisation and workplace design, above-mentioned four dimensions (Figure 1) and their interlinkage plays an important role. Aspects, such as strategic goals of the organisation, specific work processes as well as technical work equipment and the physical environment need to be addressed, assessed and described. Especially new and changing work processes (Figure 2) make it indispensable to analyse the current and future characteristics of the organisation in a very early design phase of planning to derive a well-fitting designs for work organisation and workplaces.

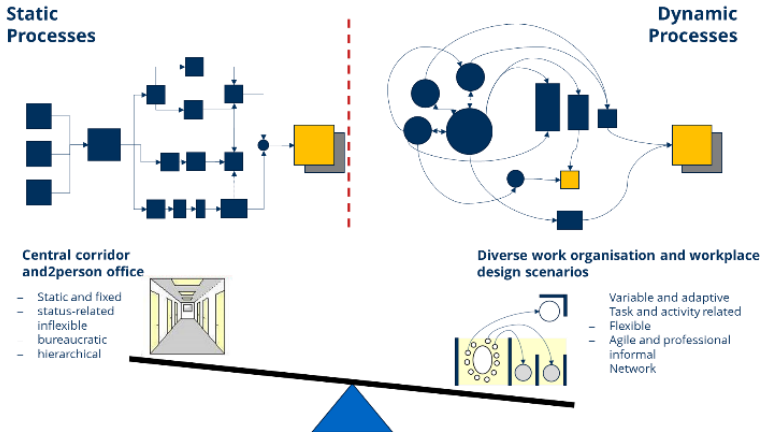

Figure 2: Balance between static and dynamic work organisation/processes in accordance with spatial workplace design. (Source: Wissensarchitektur TU Dresden)

2 Background from science and practice

Digitisation and hybrid working are current trends (Bamberg et.al. 2022) that have a massive influence on the cooperation of employees. They are related to higher flexibilisation, self-organisation, value orientation, transformation processes and hybrid work organisation. The flexibility of the place of work, working hours, work tasks and, beyond that, the division of functions between people and technology open up a different scope for design (Hofmann et al., 2019).

However, in the practical implementation in organisations and companies the high complexity of these design fields becomes notable, which goes far beyond the formulation and implementation of concepts of individual flexibility solutions. In addition to the reorganisation of work processes and workflows, their temporal and spatial flexibilisation and new competence requirements for employees –

digital systems in particular – influence and change the cooperation between people, and between people and machines. A wide variety of digital tools are already being used for collaboration, such as cloud-based platform and data exchange systems, collaboration software for project management, intranet solutions for organisational and work processes, remote systems for machine operation or messenger services for employee communication. More flexibility in working hours and the place where work activities are carried out is resulting in changes for office workspaces. There may be different reasons for using the home office, as has become a new standard during the COVID 19 pandemics, such as limiting commuting time, organising private appointments or deliberately withdrawing from the distracting office environment in order to perform more concentrated tasks. (Käfer et al., 2022).

Different office structures are possible, e.g. in the form of multi-structure offices, which spatially support new organisational concepts such as the activity-based workplace concept. However, since the work processes and contents of the employees are heterogeneous, it is important for the use of the shared space to be aligned according to suitable criteria. Activities that tend to be carried out in a quiet and concentrated manner, e.g. preparing test reports or planning and writing tasks, strongly contrast with coordination activities, meetings, advising people and informal exchanges that are carried out together in a communicative manner. The Activity-based Workplace concept provides a suitable orientation here. Here, the office space is divided into different zones (noisy/quiet, concentrated/communicative, communal/individual, etc.) and the users choose the (most) suitable place for completing the work themselves, depending on the task. Thus, workplaces are provided for quiet work as well as for joint (formal as well as in-formal) work-oriented exchange and are distributed over the area as needed.

Design science has identified the inherent planning dilemma that only towards the end of a design project a full understanding of the problem at staked is formed. So in the course of the design process, new findings on how to ensure resource-saving, needs-oriented and sustainable design planning emerge in hindsight, after decisions have been already taken.

The influence on design solution thus decrease in the course of the planning while the costs for design changes increase proportionally. For this reason, scientific research suggests a demand- and user-oriented procurement of information as a basis for design decision-making. Pena et.al. propagated user

involvement and the elicitation and translation of needs as early as possible already 1969 in the book: "Problem seeking: New directions in architectural programming in Architects, Planners, Engineers".

The establishment of planning cycles, evidence-based procedures and the application of scientific methods in monitoring, facilitation (supervision and support) and evaluation are playing an increasingly important role in the design sciences. Also from other disciplines, such as Industrial Design or Innovation Management, co-creative and evidence-based insights, cyclic principles and methods are increasingly being adapted. The principle of evidence-based design through user orientation and user insights on the one hand, and through comparative analysis of different design solutions on the other hand, is considered a resource-saving and efficient approach, as it enables higher-level learning from experience with comparable criteria (planners can carry out planning activities on a higher level of security when input variables, contexts and effects have been well described).

Christopher Alexander formulated a pattern principle for urban planning in the 1970s, by co-creating the specific patterns such as “entrance area”, “private zone” or “public zone” through a participatory process with city residents (Alexander 1977). These principles form the scientific framework of the approach presented in this paper.

3 High potentials – the feasibility study

The goal of the feasibility study was to integrate findings from (post) occupation studies and design research as well as experiences from the pandemic-related new ways of working in the administration, in order to outline new potential pathways for workplace design and work organisation as well as space management for public authorities in the federal state of Saxony. Based on the results, proposals and recommendations for new, optimised organisational and spatial concepts had to be derived and a concept for the implementation of a concrete pilot project in the form of a living lab was expected. These objectives had to be based on a systematic sequence of steps building on each other. A first step, the analysis phase, aimed at determining current and future needs, a typology of work and offices types, as well as carrying out an evaluation of the current state. The aim of the second phase was to look at the initial results in greater depth and to expand them qualitatively through the co-creative

involvement of project participants. In doing so, the connection between work tasks and activities as well as the suitable working environments should be established. The third phase aimed to develop exemplary implementation scenarios and conceptualise a possible living lab, as well as to derive recommendations for future action and the successful exploitation of the potentials identified.

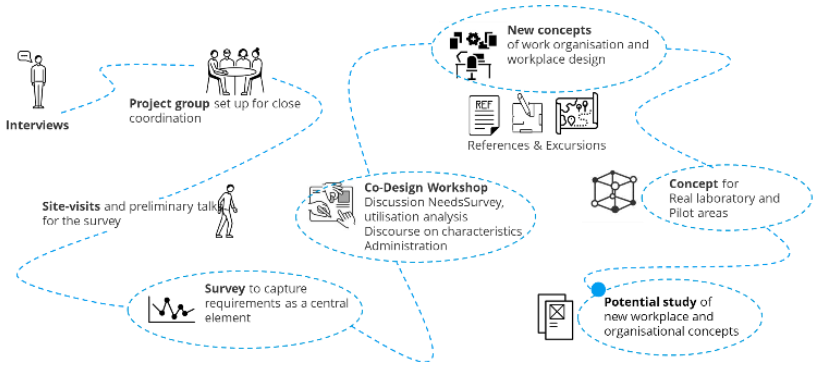

Figure 3: Methodological path of the potential study – procedural milestones. (Source: Wissensarchitektur TU Dresden)

The feasibility study of TU Dresden included seven work packages and was divided into several phases (Figure 3). The first phase comprised a detailed analysis with interviews and an extensive survey of the organisational units involved. In addition to the definition of needs and a status quo examination, a typology of work and office forms was established. In the second phase, results were deepened, supplemented and qualified together with the participating actors in a co-creative workshop. In the workshop, the participants also discussed spatial and work organisational scenarios for implementation. Within the feasibility study, the concept for a living lab was developed and a process for detailed and systematic needs assessment was outlined.

Various research questions had been formulated during the feasibility study. They concerned the future spatial design and work organisation in comparison to the current office environment and work activities, for instance:

- "What are the current work tasks and activities, utilisation needs and space requirements?"
- "How can administrative work in the organisational units to be surveyed be characterised?,

- "What potentials (space, organisation, etc.) result from the experiences for workplace and organisational concepts of the future?"
- "How can space be qualified at an early stage to meet needs?"

On such basis, the following sections of this paper reflect the overall methodological approach, the results of an online questionnaire and of the co-design workshops. It discusses the ways how needs assessments are to be conducted and how these insights are to be translated into spatial designs and organisational planning.

4 New concepts for work organisation and workplace design – a methodical approach for user-driven and co-created needs assessment

4.1 Overview of new forms of work organisation

With regard to the organisation of work, different, new forms are possible which are primarily aimed at increasing flexibility in different areas. Local flexibilisation through various forms of mobile work (e.g. home office, co-working spaces) can lead to a multiple use of office space as well as time savings for employees, e.g. by eliminating the need to travel to work. An activity-based workplace concept in the organisation supports activity-related flexibility by setting up work zones for corresponding activities. Zones that were used for concentrated work, for joint work or for informal communication were common. This usually leads to a change in work tasks and processes.

Work tasks were carried out in designated zones. When employees work from home, communicative activities tend to take place in the office, e.g. exchanges with colleagues and planned meetings. Quiet activities were more likely to be done at home. The survey also provided indications of this. The employees name as reasons for coming to the office, above all, consultations with colleagues and that documents can only be processed in the office. Spatial as well as activity-related flexibility only works if mobile technical equipment is available. This applies not only to work equipment, but above all to digital access to and digital processing options for documents.

New forms of work organisation include:

- Local flexibility: Mobile work (e.g. home office, co-working spaces), teleworking, changed spatial (office) structures in certain work zones

(activity-based workplace), multiple use of space (e.g. multifunctional offices, desk sharing),

- Time-related flexibilisation: Optional working time, trust-based working time, service hours, working time accounts
- Task-related flexibilisation: Changes in work tasks, workflows and processes, achievement due to the inclusion of hybrid forms of cooperation, expanded range of tasks
- Hybrid leadership and leadership at a distance: Leadership of employees working together in physical (analogue) and virtual (digital) spaces
- Digital communication and collaboration: Promotion of digital competences (e.g. handling software, collaborative systems, compliance with data protection), virtual teams
- Technical systems: Increased use of digital assistance systems, changed human-technology division of labour (e.g. chatbot for customer contact in administration, allgorythmisation of work)
- Cultivating a shared office and usage culture: e.g. the "clean desk concept".

An example is the "clean desk concept" which includes reliable and clear rules on how flexible workplaces and meeting zones should be used and tidied up. It also regulates how private items are handled in the office. Precisely, the clean desk principle implies that at the end of the working day, all employees should remove their personal work equipment (laptop, keyboard, computer mouse, headset, etc.) from the desk and store it in a lockable mobile container, wall cupboard, sideboard, locker or similar. For the purpose of mobile work, employees are free to take technical equipment home with them. A room or workplace booking system is required for this approach (“Who can be found where and when?”). The concept also implies a different attitude to data protection and security: all employees are required to remove documents from their desks, especially those with confidential or data protection-relevant content, so that unauthorised persons cannot view them. Other personal items should also be removed from the desk and stored away. It is not necessary to remove items (pens, punches, scissors, etc.) that are for common use. It is best to agree with the other employees in the respective home zone which items these are.

4.2 Overview of new solutions for workplace design

When designing and implementing new office concepts, structural and cultural specifics of the organisation – in addition to spatial concept – must be taken into account. Flexible work concepts, for example, must be suitable for the activities and work processes of the organisation. The organisational culture as well as participation formats for employees and their willingness to change are elementary factors for successfully introducing and adapting new work organisation and spatial concepts. Therefore, the design levels of space, organisational structure and culture, task and activity as well as the technical infrastructure should always be considered as a totality when setting up a new work organisation and space concept.

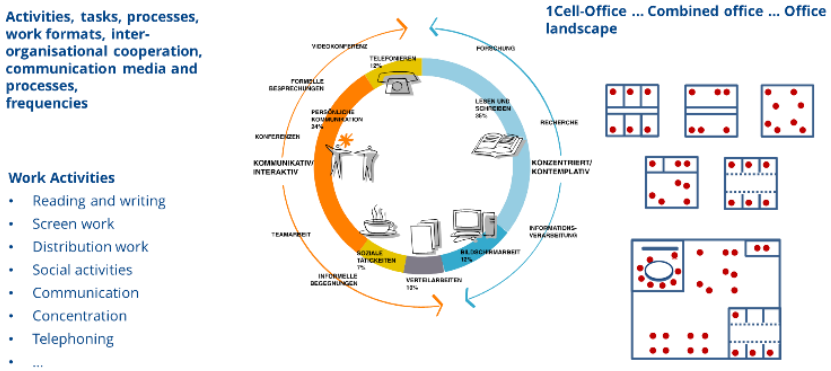

Figure 4: Interlink of work activity and user profiles with office patterns (Source: Henn architects, Wissensarchitektur TU Dresden)

There is no "one" solution for the design of new workplaces and working environments. Therefore, it is a matter of a holistic view and thus the definition of activities and work content with the survey of needs assessment (Figure 4) is crucial. This applies in particular to office construction, in order to make design, planning and construction more user- and use-oriented and multidimensional.

The first planning step of a comprehensive needs assessment is to analyse the status quo. For this purpose, the needs assessment process, the design planning but also the subsequent use should be oriented towards the following dimensions and consider them jointly. The dimensions and their input variables (see Figure 1) do not all have the same relevance to structural and floorplan design. However, due to their interactions, they are strongly linked, so that a

fundamental change does not necessarily start with a structural redesign, but also arises as a result of changing working and organisational conditions.

If possible, the needs assessment should be carried out with real users, i.e. with employees who also carry out the relevant work, activities and processes in their everyday lives. It should be ensured that not only the status quo is surveyed in the consideration of the different dimensions, but that these knowledge-holders are asked in particular for further concepts and ideas too. This applies, for example, to how work and organisational processes should be carried out in the future, or how structural relationships and functional connections can lead to better work and more efficient completion of tasks. The question in which direction the respective organisation wants to develop is also relevant for the design and solution, since the working environment should ultimately serve these goals and not counteract them.

5 Methodological Approach

5.1 Online Survey

The online survey carried out as part of the potential study serves as a general instrument to determine the specific requirements of an organisation. The survey should not only look at the current situation, but also ask about future developments and possible solutions.

The online survey was conducted in February 2022 among employees of the Saxon state administration and three other institutions. It centred around future forms of work and working environments in public administrations. More than half of the invited participants (approx. 54%) took part in the survey, which meant that a total of 724 data records could be included in the evaluation. The questionnaire developed for the study contained 34 questions with primarily closed but also open questions. They related to work activities, communication and cooperation, work processes, mobile work in the form of home office, work equipment, work environment as well as satisfaction with the current work situation and experiences with new, pandemic-related ways of working. The results formed a basis for the subsequent derivation of spatial, work organisation and technological aspects for future work environments and administration, as well as for the development of adequate spatial typologies.

5.2 Co-Design Workshop

A co-creative workshop was held with the members of the project group. This workshop served to further qualify the results of the survey. In this online workshop, new forms and scenarios of collaborative work were discussed. The participants actively contributed their input to the workshop questions via a digital whiteboard.



Figure 5: World Café - Thematic Tables "Workplace", "Meeting", "Common Area" and "Organisation" (Source: Wissensarchitektur TU Dresden)

During the workshop, the most relevant aspects – requirements for workplaces, meetings, common areas and organisation – were discussed. The aims of the workshop were 1) to discuss the implications of the aspects listed above and 2) to test and use under real-world conditions new forms of digital collaboration (digital whiteboard).

6 Results

The major results of the overall study were arranged in an analytic evaluation matrix (Figure 6) that summarises the strengths and potentials but also the potential weaknesses and risks for new work organisation and spatial concepts.

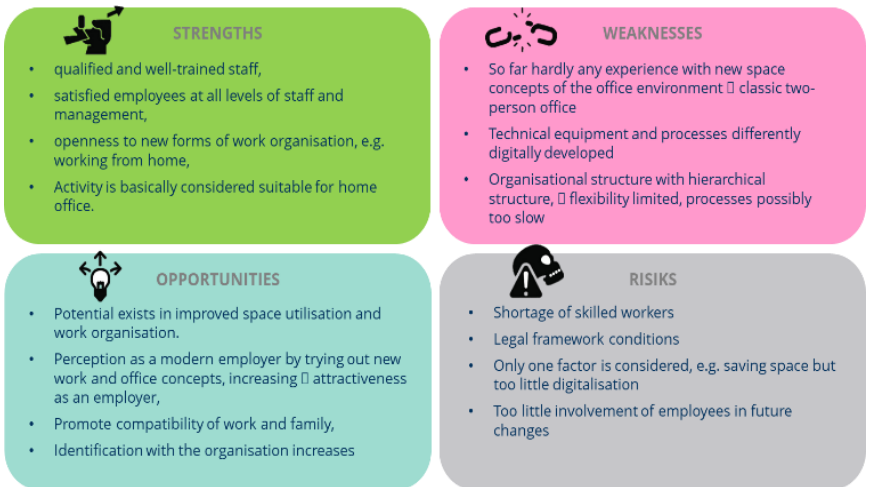

Figure 6: Analysis and evaluation matrix (Source: TU Dresden)

6.1 Findings and results of the (online) questionnaire

Based on the survey, detailed results could be determined for the four dimensions of the matrix. The following paragraphs excerpt some of the results which shed light on the activity, place of work, mobile work, degree of digitalisation and satisfaction of the employees surveyed.

The activities in the four studied administrative units are characterised on the one hand by daily work with the PC and on the other hand by a high proportion of telephone calls. Typical tasks are, for example, working with files, case discussions, concept work, preparation of statements and notes, research or evaluating measures. A large part of the tasks can be digitally supported. However, certain respondent groups work significantly more with paper files than other units. This is partly due to a different degree of digitalisation in the institutions. Figure 7 shows the results for the work tasks and activities.

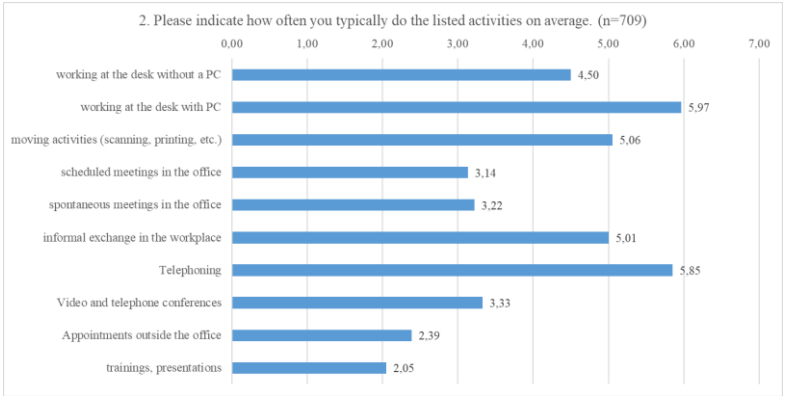

Figure 7: Work tasks and activities in the sample. (Source: CIMTT TU Dresden)

98% of the respondents in the total sample have a fixed office workstation. Only very few people have two fixed workplaces in different units or no fixed workplace (2%). 23% of the respondents work in a single office, 53% of the respondents sit in a room with another person. Of the participants, 18% work with two other people in the room. The fewest number of respondents sit in an office with three or more people (6 %). This means that there is a conventional two-person office structure in most of the areas surveyed. Before the COVID-19 pandemic, most employees in the sample worked in the office. Only a few people were able to work in a home office. As regards the future, 92 % of the respondents would generally like to have the opportunity to work in a home office to a certain extent. More precise results are shown in Figure 8. Furthermore, 85% of the respondents consider their job suitable for working in a home office.

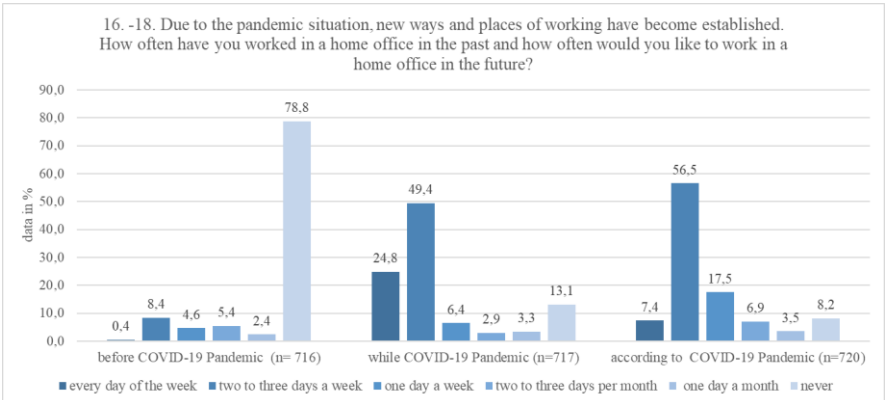

Figure 8: Home office before, during and after the COVID-19 Pandemic. (Source: CIMTT TU Dresden)

From the respondents' point of view, the main reasons for working in a home office are the better compatibility of work and family, the elimination of long commutes and flexible, and the chance for individual working. As reasons for coming to the office, the interviewees mainly mention the exchange with colleagues, the well-equipped workplace, the technical equipment as well as documents that can only be processed in the office. Exact results are shown in Figure 9.

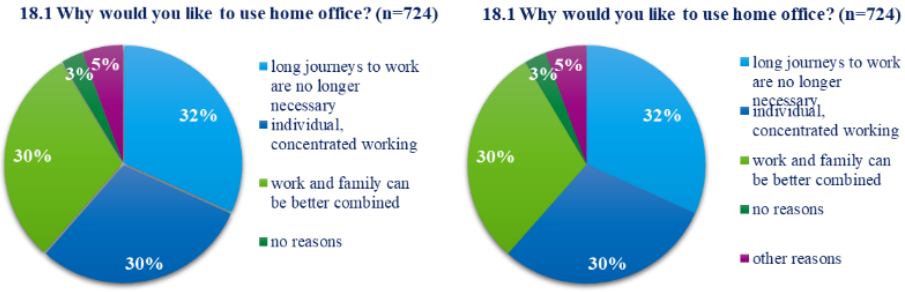

Figure 9: Left: Reasons to choose home office; Right: reasons to choose office. (Source: CIMTT TU Dresden)

6.2 Discussion and results of co-design workshop

Within the feasibility study, the four relevant aspects – requirements for workplaces, meetings, common areas and organisation – were reflected. The results of the survey and the functional relationships in terms of organisation and space were discussed, but also the fact that it is always a discursive process of weighing up on "how much of what" is sensible, financially viable and necessary in accordance with requirements. In a four-hour online workshop with the members of the project group, following questions and aspects were explored for the two scenarios (1) "Narrow old world" and (2) "Flexible new world":

- "What from this scenario fits well with us because ...?", and
- "What from this scenario irritates / does not fit to us, because ...?"

The aim was to identify functional relationships between activities and spatial requirements. Furthermore, in the two different scenarios, the aim was to adopt different perspectives and to rethink office and working conditions.

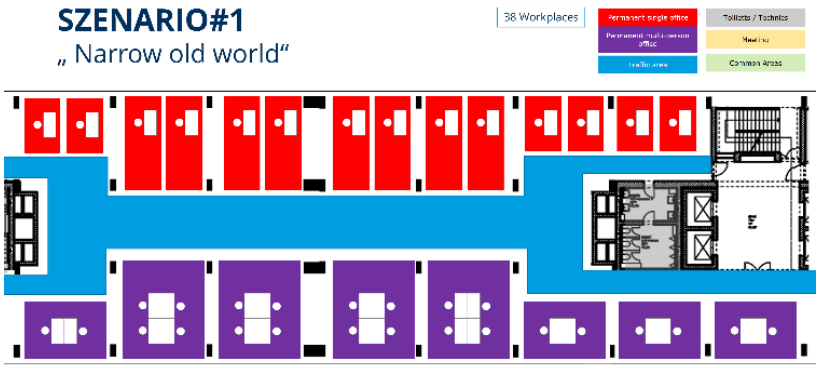

Figure 10: Floorplan visualisation of scenario 1 – „Narrow old world“ (Source: Wissensarchitektur TU Dresden)

What from this scenario suits us well because ...?	• Single room/ file room available • clear work structure, little organisational effort • my computer at my workplace • Flexibility for everyday work without prior organisational effort • Everyone knows where everyone is placed and who is in reach But: "lone warriors" (controlling, lawyers) can also work well and concentrated at home.
What from this scenario is irritating / does not suit us because ...?	• lack of meeting rooms • different communication zones are missing • Semi-public communication zones are missing • There are no further education and training rooms Physical proximity of administrators and staff is advantageous, but communication sometimes interferes with concentrated work.

Figure 11: Summary of Workshop Participants Feedback of Scenario 1 - „Narrow old world“



Figure 12: Floorplan visualisation of scenario 2 – „Narrow old world“ (Source: Wissensarchitektur TU Dresden)

What from this scenario suits us well because ...?	Communication areas • Professional exchange and better communication, also informal • Topics are discussed more readily/openly and together through spontaneous encounters (idea generator) Flexibilisation • Increased effectiveness as added value • Space adaptable to team size • Flexibility in choice of workplace, no fixed workplace necessary Workplaces • Permanently allocated office space and archive rooms Meeting • Consultation rooms and informal consultation zones for short-term consultations • Meeting rooms of different sizes Community areas • Balancing zone between concentrated work/recreation times • Appreciation through common areas
What from this scenario is irritating / does not suit us because ...?	Organisational culture • We like what we know and what we have. • Opening up to new things is difficult • How are organisation units accommodated housed together Organisational effort • Fixed working structures need to be revised • Organisation of the different areas • How do I get my files? Data protection • Open work not possible, §30 AO tax secrecy • Data protection regulations! • no data about third parties on files (taxes) may be disclosed Acoustics • undisturbed work in case of noise or interruptions (depending on the person) • A lot of work with numbers, data and facts--> Volume of telephone calls raises the noise level.

Figure 13: Summary of Workshop Participants Feedback of Scenario 2 - „Flexible New World"

The World Café phase of the workshop dealt with four thematic tables on the topics of "workplaces", "meeting", "communal areas" and "organisation". Through rotation, many suggestions were collected in a short time, and participants had the opportunity to express themselves on all four topics.

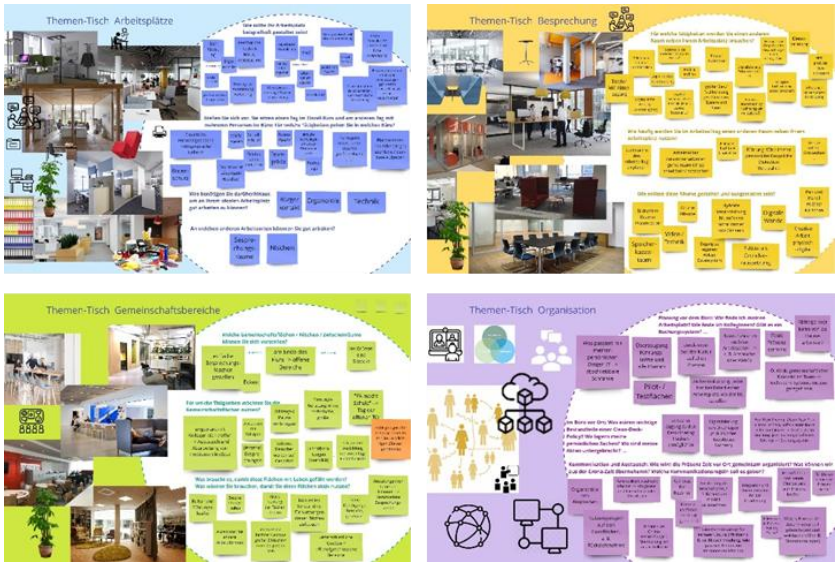

Figure 14: Visual summary of the participant feedback (Source: Wissensarchitektur TU Dresden)

7 First implications for practice

There is potential for new forms of work organisation as well as for new office space concepts in the surveyed administration and the subordinate areas. The respondents assess their work activities as suitable for mobile work in the form of home office and there is a high willingness to use home office as a new form of work. However, there are also workplaces in all the units surveyed that are fixed and have no equivalent in a home office due to certain work equipment (e.g. files, special hardware) and activities (e.g. consultation hours for customers). This must be taken into account in agreements in order to avoid dissonance in workforces. Furthermore, the use of a home office can lead to employees giving up personal space in the office. Organisational variants for workplaces can be desk sharing or room sharing, i.e. several employees share workplaces or work zones in these cases. Both concepts require good planning and self-organisation on the part of the employees as well as clear and transparent rules and structures on the part of the employer. The integration of a booking tool for the workplaces is recommended. Spatial potentials arise from spaces that become vacant due to home office. Office space can be qualitatively upgraded by making more work zones usable for collaboration and coordination. This also includes niches and extended workspaces that temporarily serve as flexible workplaces. Multi-

functionality and flexibility of rooms and spaces increase the possibilities for use. Meeting rooms can be used for exchanges with colleagues (e.g. teamwork, annual meetings, project coordination) as well as for telephone calls and concentrated work. Furthermore, space savings are possible to a certain extent by using or subletting space from other departments.

Hybrid working requires a suitable technical environment. First and foremost, this includes a secure IT infrastructure that allows employees remote access to documents and data. With continuous, digital processing of documents, access is possible regardless of location and work can thus be organised more flexibly. At the individual level, hybrid working can result in work being structured differently. Quiet work tasks with longer periods of concentration are more likely to be moved to the home office. Exchanges, meetings and group work phases with colleagues are more likely to take place during working hours in the office. Employees are given more leeway in deciding how to organise their work and schedule it more flexibly. This usually leads to a better reconciliation of work and family demands and promotes self-organisation among employees. For the implementation of measures regarding new work organisation and office space concepts, it is important to always consider the four dimensions "organisational structure and culture", "people and activity", "space and area" and "media and technology" in combination and not separately.

7.1 Translation of needs assessment into spatial and organisational patterns

As a translation and verification step of the collected requirements and needs, visualisation techniques are suitable to give the involved stakeholders quick access to complex content. Moreover, to open up content and consideration processes on key issues as: “What is needed, and how much of it?”, “Priorisation of functions and needs”, or “Sequence and temporal order of process steps” need to be graphically displayed. Visualisation techniques are useful to discuss jointly with the users and user representatives, to be able to discuss on eye-level and finally to speed up decision-making processes. Another helpful step in translating work requirements and identified needs into spatial patterns is shown in Figure 15. As an example, it visualises the basic functions of an office environment with a detailed characterisation of the workplaces. This translation service is flanked by modular patterns, icons or 3D visualisations of the facts (see also Figure 17).

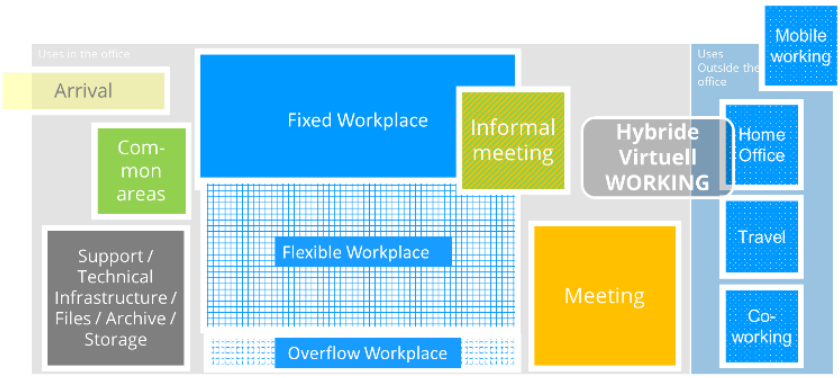

Figure 15: Subdivision of the functional area "workplace" into fixed, flexible and overflow workplaces (Source: Wissensarchitektur TU Dresden)

With regard to the organisation of the workplaces, the following scenario could arise in the division of the workplaces:

- There are *fixed workplaces with team assignment* for people who work in the office at least four days a week (and at least 6 hours a day). When planning and organising the fixed workplaces, special attention should be paid to inclusive workplaces. For persons with special requirements these workplaces are reserved. When the respective persons are working in a home office, it is possible for other employees to use the workplace as well.
- There are *flex workstations with team allocation* for people who work in the office two to three days a week (and at least 6 hours a day). These workplaces use a desk sharing solution, e.g. three people share two workplaces.
- There are *flex workplaces without team allocation* that function as so-called overflow workplaces. These workstations are used by employees who have a telecommuting workstation or who work in the office for a maximum of one day a week. Workplaces in meeting rooms can be used for this purpose or employees can be attached to teams with desk sharing.

Figure 16 shows an application example for the distribution of workstations when the principle of desk sharing is applied in a team of six people. In the example shown, two employees use fixed workplaces as they do their work in presence in the office. Three colleagues work hybrid and come to work in the office between two and three days. The sixth person in the team has a

telecommuting workstation and comes to work in the office no more than once a week.

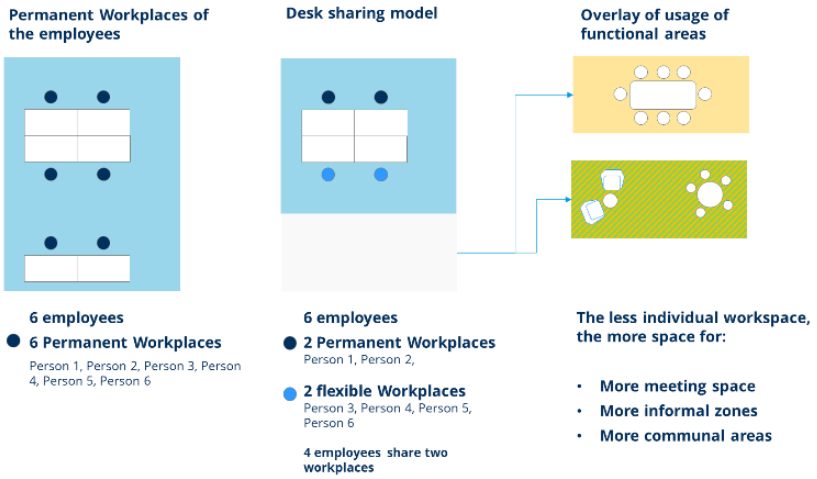

Figure 16: Desk Sharing - example for the distribution of workstations (Source: Wissensarchitektur TU Dresden)

8 Outlook

User-oriented needs assessment should be designed co-creatively – i.e. together with the users – as a process with the following steps (Fig. 17):

a) Basic survey (online survey) of the factual situation, the actual state as well as the target state;
b) Co-creative evaluation and accentuation of the requirements of the basic survey together with the users;
c) Translation of technical, spatial, organisational requirements into workplace design and organisational concepts.

A test phase of potential spatial and organisational configurations still before the implementation in new floor plans and new working procedures and methods are very usefully, especially in public administrations.

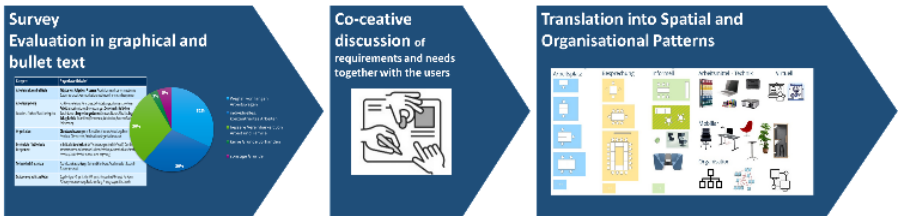

Figure 17: Process steps of elicitation, co-creative qualification and translation of requirements into spatial patterns and organisational rules of use (Source: Wissensarchitektur TU Dresden)

During a qualitative and quantitative needs assessment, it is necessary to have goal-oriented controller discussions for all dimensions and aspects in order to enrich the design task with the right premises ("How-much-of-what?"). Figure 18 visualises some basic aspects that help clarifying the functional relationships between activities and spatial requirements.

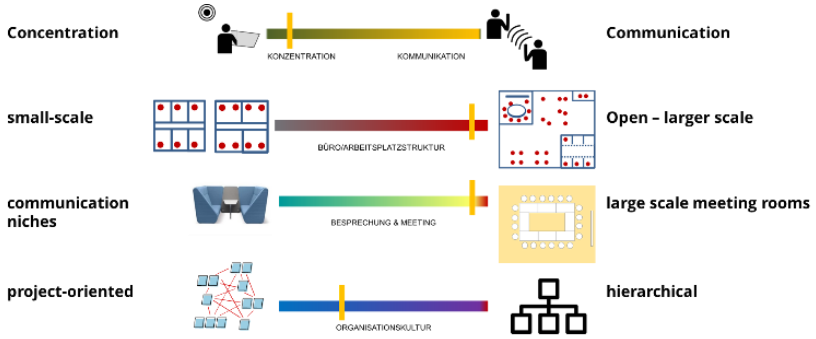

Figure 18: Patterns of the regulating principle for decision-making during the needs assessment (Source: Wissensarchitektur TU Dresden)

The aspects of the workplace, meeting rooms, communal areas and organisation, together with the activities that will take place in the rooms in the future, are decisive for the design of new solutions for a needs-oriented working environment. The quality of future work organisation and workplace concepts depends on the organisational, i.e. structural and cultural conditions, the spatial requirements and possibilities, the work activities to be carried out and the technical infrastructure. Only a common understanding of how the framework conditions on the individual dimensions should be designed beyond the mere use of space will lead to new concepts in work organisation and space design. For an activity-oriented form of office design, the respective requirements for the

workplace, the meeting areas and the common areas should be defined with the users at an early stage and the number of fixed, flexible and overflow workplaces should be ascertained, as well as a possible flexibilisation through temporary workplaces (niches, meeting rooms). Space allocations should be related to the smallest organisational unit, the "team" and its functional and work-organisational context. Rules of use, such as the acceptable noise level in rooms or zones, must be found together. However, these agreed rules of use may have to be adapted to new working conditions, and are subject to repeated change. Regular monitoring is recommended to be able to adjust the user- and usage-driven spatial and organisational measures.

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Open Innovation Activities and Firm Performance: A Comparison between Pre-Crisis and Post-Crisis

Marco Greco

Department of Civil and Mechanical Engineering
University of Cassino and Southern Lazio
Via G. Di Biasio 43, Cassino (FR), 03043 (Italy)

Michele Grimaldi

Department of Civil and Mechanical Engineering
University of Cassino and Southern Lazio
Via G. Di Biasio 43, Cassino (FR), 03043 (Italy)

Livio Cricelli

Department of Industrial Engineering
University of Naples "Federico II"
Piazzale Tecchio 80, 80125, Napoli (Italy)

Serena Strazzullo

Department of Industrial Engineering
University of Naples "Federico II"
Piazzale Tecchio 80, 80125, Napoli (Italy)

Benito Mignacca*

Department of Civil and Mechanical Engineering
University of Cassino and Southern Lazio
Via G. Di Biasio 43, Cassino (FR), 03043 (Italy)

** Corresponding author*

Abstract

Innovation played a relevant role in coping with the related economic-financial consequences of the 2008 crisis. In particular, several studies show the pivotal role of open innovation activities in responding to 2008 crisis-related downturn conditions. Remarkably, previous studies share several limitations. First, they leverage single-country data or single sectors to examine open innovation activities. Second, they examine open innovation activities and firm performance through binary comparisons between either pre-crisis and

crisis or crisis and post-crisis periods. An overall view of how the outburst of a crisis altered the 2008 pre-crisis collaboration strategies and how such strategies changed after the 2008 crisis is a relevant gap in knowledge. This article addresses this gap in knowledge by examining open innovation activities and firms' performance through a binary comparison between pre-crisis and post-crisis periods. In particular, this article analyses a repeated cross-sectional sample of firms from 13 European countries interviewed during 5 consecutive Community Innovation Survey waves. This article shows how after the crisis, European firms reduced – on average – the variety of their innovation partners. Such a loss was recovered only in 2012-2014. The outburst of a crisis seems negatively associated with the propensity towards open innovation and, specifically, with the number of different collaboration channels exploited by a firm to innovate. A crisis may urge firms to focus their energies on fewer collaboration channels to make the most out of them. The results also emphasise that the financial crisis temporarily reduced innovativeness. Interestingly, the results show that the positive relationship between collaboration breadth and innovation performance is more marked in the post-crisis wave for the firms more active in open innovation.

Keywords – Open innovation, Recession, Crisis, Interorganizational collaboration, Innovation performance

Paper type – Academic Research Paper

1 Introduction

A crisis can be defined as '*the process by which economic life adapts itself to new conditions*' (Schumpeter 1934, 218). In the case of the 2008 financial crisis, innovation – in all its multifaceted forms – played a relevant role in coping with the related economic consequences (Lee, Sameen, and Cowling 2015; Colombo et al. 2016). In particular, several studies show the pivotal role of open innovation (OI) activities in responding to the downturn conditions in the case of the 2008 financial crisis (Chesbrough and Garman 2009; Laperche, Lefebvre, and Langlet 2011; Skålholt and Thune 2014; Mandják, Wimmer, and Durrieu 2017; Filippetti and Archibugi 2011; Zouaghi and Sánchez 2016; Zouaghi, Sánchez, and Martínez 2018). Remarkably, previous studies share several limitations. First, they resort to single-country data or single sectors. Second, they examine OI activities and firms' performance through binary comparisons between either pre-crisis and crisis or crisis and post-crisis periods. An overall view of how the outburst of a crisis altered the 2008 pre-crisis collaboration strategies and how such strategies changed after the 2008 crisis is a relevant gap in knowledge. This article addresses this gap in knowledge (Sandberg and Alvesson 2011) by examining OI

activities and firms' performance through binary comparison between pre-crisis and post-crisis periods. In particular, this paper addresses the following research questions (RQs):

RQ1: How can a crisis alter the collaboration strategies of European firms?
RQ2: How can a crisis alter the relationship between innovation performance and collaboration of European firms?

The rest of the paper is structured as follows. Section 2 presents the theoretical background. Section 3 details the methodology adopted. Section 4 and Section 5 present and discuss the results, respectively. Section 6 concludes the paper.

2 Theoretical background

Several studies examine the relationship between a crisis and OI initiatives, agreeing on the relevance of OI practices to contrast the effects of a crisis. One of the first studies on OI and crisis highlights how a purposive approach to OI projects determines an increase in the volume of external technology transfer, thereby producing huge inflows of financial resources (Di Minin, Frattini, and Piccaluga 2010). Additionally, by examining OI activities in large industrial firms, Laperche, Lefebvre, and Langlet (2011) point out that some firms resisted the crisis by rationalising R&D expenses, strengthening OI strategies, and developing skilful use of intellectual property rights. Papadopoulos et al. (2013) illustrate the case of Greece, examining OI practices and their applicability in a crisis. The findings suggest the importance of shifting from open-source software to OI practices to foster innovation and growth.

Furthermore, building on a quantitative analysis of 300 companies and examining clusters as forms of firm collaborations, Skalholt and Thune (2014) show that clusters are important for coping with the immediate impact of a financial crisis. In particular, the results show that clusters can stimulate innovation by capitalising on the opportunity of the crisis itself. Mandjàk et al. (2017) analyse the network behaviour, suggesting that an early understanding of the impending crisis strongly influences the network behaviour, pushing the company to intensify customer relationships. Ramella (2017) investigate the performance of firms owning European patents during the economic downturn, emphasising the importance of collaborative company culture to deal with the related economic-financial challenges.

Moreover, Zouaghi, Sánchez, and Martínez (2018) examine the role of internal and external knowledge in high-tech and low-tech firm innovation performance during the economic crisis. By analysing panel data from 13,000 Spanish firms, the authors point out that collaboration is crucial to both high and low-tech industries during a crisis, and comparatively more important for low-tech firms. Additionally, in an investigation about the persistence of adopting an open strategy during the economic downturn of 2008, Ahn, Mortara, and Minshall (2018) analyse the longitudinal impact of openness, its relationships with dynamic capabilities, and firms' innovation resilience. By leveraging manufacturing firms' data from three waves of the UK Community Innovation Survey, they find that an open approach can improve dynamic capabilities, which are necessary to adapt to a "slowing down" economy.

3 Methodology

3.1 Dataset

The dataset draws from five consecutive waves of the Community Innovation Survey (CIS), from the 2006 wave (reference years 2004-2006 inclusive) to the 2014 wave (reference years 2012-2014 inclusive), covering both the pre-crisis and the post-crisis periods. CIS surveys are data frequently used in the OI literature (Garriga, von Krogh, and Spaeth 2013; Leiponen 2012; Laursen and Salter 2006). Since compiling CIS data is voluntary, different waves can see the participation of different countries. This study targets those countries that participated more frequently in the waves under investigation, including Bulgaria, Cyprus, Czech Republic, Germany, Estonia, Spain, Hungary, Italy, Lithuania, Norway, Portugal, Romania, and Slovakia. Based on the European innovation scoreboard[1], the aforementioned countries include both innovative and less innovative ones. Notably, some country-wave combinations are missing: Germany (2006) and Italy (2006 and 2014). Overall, the resulting repeated cross-sectional dataset used in the main model includes 181,454 firms in 13 countries. CIS surveys draw from the statistical business register of each country. The random sampling and the likely presence of a stable subset of firms in multiple waves allow assuming that the samples in the waves are not systematically different from one another.

[1] *https://ec.europa.eu/commission/presscorner/detail/en/ip_21_3048*

3.2 Variables and methods

In order to address the first RQ, i.e. "How did the 2008 crisis alter the collaboration strategies of European firms", this study presents regression models on a dependent variable describing how innovation-oriented collaboration activities vary with time. Such a dependent variable, *collaboration breadth*, assesses the variety of the collaboration channels used by a European firm, as exemplified in Table 1.

Table 1: Description of the items composing the collaboration breadth variable

Please indicate the type of innovation co-operation partner by location				
Type of co-operation partner	**[Your country]**	**Other Europe**	**United States**	**All other countries**[1]
Suppliers of equipment, materials, components, or software				
Private or public clients or customers				
Competitors or other enterprises in your sector				
Consultants, commercial labs, or private R&D institutes				
Universities or other higher education institutions				
Government or public research institutes				

For each collaboration channel (e.g. suppliers, universities), the respondent can select up to four possible geographical locations. A higher number of channel/location combinations selected by the respondent denotes that his/her firm collaborates with more partners on its innovation activities. The propensity to engage in multiple innovation collaborations is quantified by summing all the combinations chosen, defining the *collaboration breadth* variable. For instance, a firm that collaborated with suppliers and universities from its country and a supplier from the United States would have *collaboration breadth=3*. Thus, *collaboration breadth* is included in the range 0–24. This approach to assessing *collaboration breadth* is similar to others previously adopted in the OI literature

[1] *Some waves dedicated additional columns to specific countries (e.g., CIS 2008 specified a fifth column with "China or India"). In those circumstances, to maintain the longitudinal consistency of the variable, we assigned the tick to "All other countries" by construction.*

(Poot, Faems, and Vanhaverbeke 2009; Drechsler and Natter 2012). The variable is skewed to the left (more than 75% of the sample declared no active collaboration). However, ordinary least squares models are potentially unsuitable to describe distributions with such a nature, whereas Tobit models represent a valid alternative (Amore and Murtinu 2021). Therefore, this article resorts to left-censored Tobit regression models to account for the previously mentioned left-skewness.

In order to address RQ2, i.e. "How did the 2008 crisis alter the relationship between innovation performance and collaboration of European firms?", this study uses collaboration breadth as an independent variable associated with an innovation performance dependent variable. Innovation performance is measured as *new-to-the-market*, a binary variable that takes the value 1 if the firm introduced a new or significantly improved good or service into the market before its competitors, 0 otherwise. The binary nature of the innovation performance variable induces the use of Logit regression models, specifically aimed at studying binary variables. Notably, the coefficients in Logit models refer to a standard deviation change in the logit of the dependent variable and not in the dependent variable per se.

CIS surveys provide additional innovation performance variables, but this article focuses on the *new-to-the-market* one due to the following shortcomings of the others:

- *new-to-the-world* innovations are more likely to happen in larger firms. Most firms in the sample and the population are small and medium-sized enterprises.
- *new-to-the-firm* innovations capture the novelty to a lesser extent than *new-to-the-market* innovations.

The main independent variable of the study, *wave,* describes the five CIS waves from which the dataset is drawn. Since the dataset used in this research does not allow a longitudinal analysis, *wave* is used as a factor variable. Therefore, the regression models report the coefficients of four waves (2006, 2010, 2012, and 2014), each compared with the base value (the CIS 2008 wave, with reference years 2006-2008), which allows grasping the pre-crisis and post-crisis differences. For instance, a statistically significant and negative wave coefficient would mean that the dependent variable was smaller during such a wave than in CIS 2008.

In order to verify the 2008 crisis altered the relationship between innovation performance and collaboration of European firms (RQ2), the regression models

present interaction terms between the *collaboration breadth* and the virtual *wave* dummies. A statistically significant interaction term would indicate that the effect of an increment of *collaboration breadth* on the dependent variable is different (stronger or weaker) at different *wave* values. Therefore, positive and statistically significant post-crisis interaction terms between *collaboration breadth* and *wave* would indicate a stronger effect of *collaboration breadth* on performance than in crisis time.

Other control variables include *R&D intensity, size*, *innovation abandonment,* country and NACE section dummies. *R&D intensity*, defined as the ratio of total R&D expenditures on sales (Berchicci, de Jong, and Freel 2016), is a proxy for the absorptive capacity of a firm (Cohen and Levinthal 1990), a known moderating factor of the relationship between OI and innovation performance (Huang and Rice 2009). In order to avoid the presence of outliers, the values of *R&D intensity*>1 are set to missing. The variable *size* is estimated as the logarithmic transformation of the sales size of a firm. The variable is included since larger firms are likely to be involved in larger networks of collaborations and are more likely to obtain new-to-the-market innovations than smaller firms (Cheng and Huizingh 2014). During a crisis, many firms may want to reduce their investments in innovation (Archibugi, Filippetti, and Frenz 2013), negatively impacting their chances of introducing a new-to-the-market innovation. Therefore, the models control for the *innovation abandonment* dummy variable, which takes the value of 1 if at least an innovation project was abandoned or suspended before completion during the same time horizon of the innovation performance dependent variable. Country and NACE section dummies are included to consider how different sectors and countries were hit by and reacted to the crisis and control these factors while attempting to address the RQs. Based on the European Innovation Scoreboard 2008 (Pro Inno Europe 2009), the firms in the sample are also described by the variable *eis*. The variable takes three values according to the country innovativeness indicated in the scoreboard: 'innovation leader' (Germany); 'moderate innovator' (Cyprus, Czech Republic, Estonia, Spain, Hungary, Italy, Norway, Portugal); and 'catching up' (Bulgaria, Hungary, Lithuania, Romania, Slovakia).

Table 2 summarises the descriptive statistics of the variables and the cardinality of the sample in the five CIS waves, along with the 13 countries. The software package STATA was used to conduct the analyses.

Table 2: Descriptive statistics and number of observations per country

Variable	**Observations**	**Mean**	**Standard deviation**	**Min**	**Max**	
collaboration breadth	181'454	0.89	2.040	0	24	
new-to-the-market	126'085	0.43	0.495	0	1	
innovation abandonment	126'085	0.22	0.414	0	1	
size	181'454	15.44	2.019	9.21	25.06	
R&D intensity	181'454	0.02	0.087	0	1	
eis	181'454	1.96	0.066	1	4	
Country (observations)	**2006**	**2008**	**2010**	**2012**	**2014**	**Total**
Bulgaria	3'024	2'979	2'603	2'390	1'588	12'584
Cyprus	425	473	392	388	462	2'140
Czech Republic	6'703	2'812	2'068	2'262	2'303	16'148
Germany	0	4'892	1'761	5'257	0	11'910
Estonia	1'063	2'232	930	760	258	5'243
Spain	14'683	16'113	15'147	12'699	8'111	66'753
Hungary	1'338	1'448	1'332	210	529	4'857
Italy	0	3'119	17'723	6'455	0	27'297
Lithuania	719	1'402	636	628	1'097	4'482
Norway	1'229	661	571	1'309	2'134	5'904
Portugal	2'172	3'766	3'409	3'338	2'678	15'363
Romania	2'250	2'399	618	247	148	5'662
Slovakia	811	646	668	549	437	3'111
Total	34'417	42'942	47'858	36'492	19'745	181'454
NACE sector (observations)	2006	2008	2010	2012	2014	Total
A	0	338	295	276	28	937
B	0	424	270	304	98	1,096
C	5,055	23,622	21,266	18,116	10,477	78,536
D	14,930	532	602	508	238	16,810
E	606	1,174	886	1,049	280	3,995
F	1,439	1,418	4,481	1,391	583	9,312
G	0	4,397	7,720	3,937	2,425	18,479
H	4,524	2,080	2,513	1,745	1,002	11,864
I	0	296	191	139	68	694

J	2,521	3,136	3,383	3,311	1,276	13,627
K	387	1,642	1,918	1,345	765	6,057
L	0	80	41	27	30	178
M	4,955	3,009	2,977	2,928	1,555	15,424
N	0	794	461	634	282	2,171
P	0	0	84	78	66	228
Q	0	0	553	528	452	1,533
R	0	0	96	90	53	239
S	0	0	121	86	67	274

Notes: descriptive statistics refer to the observations used in Models 1-2, except for new-to-the-market and abandonment, which refer to Models 3-5. NACE sectors: A, Agriculture, Forestry and Fishing; B, Mining and Quarrying; C, Manufacturing; D, Electricity, Gas, Steam and Air Conditioning Supply; E, Water Supply; Sewerage, Waste Management and Remediation Activities; F, Construction; G, Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles; H, Transportation and Storage; I, Accommodation and Food Service Activities; J, Information and Communication; K, Financial and Insurance Activities; L, Real Estate Activities; M, Professional, Scientific and Technical Activities; N, Administrative and Support Service Activities; P, Education; R, Arts, Entertainment and Recreation; Q, Human Health and Social Work Activities; S, Other Service Activities.

4 Results

The first RQ, i.e. "How did the 2008 crisis alter the collaboration strategies of European firms?", is addressed through two left-censored Tobit regressions on the dependent variable collaboration breadth (reported in Table 3). Heteroscedasticity is controlled by using robust standard errors. Since the AIC value of Model 2 is statistically significantly better than the one in Model 1 (the baseline), introducing the variable wave – which allows studying how OI activities changed after the 2008 crisis - improves the quality of the model.

Table 3: Tobit regressions on collaboration breadth

	Model 1 (baseline)		**Model 2**	
	Coeff (S.E.)	P	Coeff (S.E.)	p
wave (w.r.t. CIS 2008)				
CIS 2006 ↓			-1.17 (0.055)	0.000
CIS 2010 ↑			-0.20 (0.047)	0.000
CIS 2012			-0.14 (0.045)	0.002
CIS 2014			0.01 (0.051)	0.924
size	0.70 (0.01)	0.000	0.70 (0.01)	0.000
R&D intensity	10.58 (0.178)	0.000	10.38 (0.177)	0.000

eis (w.r.t. Catching up country)				
Moderate innovator	0.61 (0.082)	0.000	0.56 (0.082)	0.000
Innovation leader	-0.93 (0.094)	0.000	-1.09 (0.096)	0.000
country dummies	Included	0.000	Included	0.000
NACE dummies	Included	0.000	Included	0.000
AIC	402'183.2		401'680.2	
Test AIC (Hp0: AICMod1=AICMod2)			(Mod4 vs Mod3)	0.000
Log-pseudolikelihood	-201'058.59		-200'803.1	
Pseudo R2	0.0565		0.0577	
Observations	181'454		181'454	

Two main results can be observed in Table 3. First, the negative and statistically significant wave coefficient of CIS 2006 with respect to CIS 2008 suggests that the firms interviewed in the 2006 wave were less engaged in collaboration breadth than those in 2008. This emphasises that the economic system was experiencing a growth in OI-related activities before the 2008 crisis. Indeed, the value of collaboration breadth is 1.17 points lower for a firm in the 2006 wave than in 2008. Second, the negative and statistically significant wave coefficients of the post-crisis CIS waves compared with the 2008 wave indicate that the firms involved in the post-crisis period were significantly less engaged in collaboration breadth than those in the 2008 CIS wave. Hence, this shows a durable and significant withdrawal from OI activities, whose pre-crisis level was recovered only in the 2014 wave. The control variables show, as expected, that larger firms and firms investing more in R&D are more likely to collaborate with other organizations. More surprisingly, firms based in catching-up countries have – on average – smaller collaboration breadth values compared to firms based in moderate innovator countries and larger collaboration breadth values compared to firms based in an innovation leader country.

The second RQ, "How did the 2008 crisis alter the relationship between innovation performance and collaboration of European firms?", is addressed through three Logit regressions on the dependent variable new-to-the-market (Table 4). The models use robust standard errors to control for heteroscedasticity. Model 3 is the baseline, while Model 4 includes the wave variable, and Model 5

includes the interaction term between wave and collaboration breadth. Several insights can be drawn.

First, the coefficients of collaboration breadth are positive and statistically significant in all models, emphasising a positive relationship between OI and innovation performance. The relationship between performance and collaboration breadth is expected to diminish returns or to take the form of an inverted U-shape (Radicic et al. 2019; Greco, Grimaldi, and Cricelli 2016). Therefore, the regression models also consider the squared term of collaboration breadth. As expected, its coefficients are statistically significantly negative.

Table 4: Logit regressions on innovation performance (new-to-the-market)

	Model 3 (baseline)		**Model 4**		**Model 5**	
	Coef. (S.E.)	P	Coef. (S.E.)	p	Coef. (S.E.)	p
collaboration breadth	0.26 (0.006)	0.000	0.25 (0.006)	0.000	0.24 (0.008)	0.000
collaboration breadth2	-0.01 (0.001)	0.000	-0.01 (0.001)	0.000	-0.01 (0.001)	0.000
wave (w.r.t. CIS 2008)						
CIS 2006 ↓			-0.44 (0.025)	0.000	-0.39 (0.027)	0.000
CIS 2010 ↑			-0.21 (0.019)	0.000	-0.3 (0.021)	0.000
CIS 2012			0.09 (0.020)	0.000	0.09 (0.021)	0.000
CIS 2014			0.09 (0.024)	0.000	0.1 (0.027)	0.000
wave*collaboration breadth (w.r.t. CIS 2008)						
CIS 2006 ↓					-0.04 (0.009)	0.000
CIS 2010 ↑					0.09 (0.01)	0.000
CIS 2012					-0.01 (0.009)	0.328
CIS 2014					0 (0.011)	0.679
Innovation abandonment	0.5 (0.016)	0.000	0.55 (0.016)	0.000	0.55 (0.016)	0.000
Size	0.06 (0.003)	0.000	0.06 (0.003)	0.000	0.06 (0.003)	0.000

R&D intensity	2.75 (0.125)	0.000	2.69 (0.125)	0.000	2.69 (0.125)	0.000
eis (w.r.t. Catching up country)						
Moderate innovator	-0.15 (0.031)	0.000	-0.17 (0.031)	0.000	-0.17 (0.030)	0.000
Innovation leader	-1.37 (0.032)	0.000	-1.47 (0.034)	0.000	-1.48 (0.034)	0.000
country dummies	Included	0.000	Included	0.000	Included	0.000
NACE dummies	Included	0.000	Included	0.000	Included	0.000
AIC	152580.3		151937.7		151720.6	
Test AIC (Hp0: AICModi=AICModj)			(Mod4 vs Mod3)	0.000	(Mod5 vs Mod4)	0.000
Log-pseudolikelihood	-76255.152		-75929.826		-75817.294	
Pseudo R2	0.1157		0.1195		0.1208	
Observations	126,085		126,085		126,085	

Second, in Model 4, the negative and statistically significant wave coefficient of CIS 2006 (compared with CIS 2008) suggests that the firms interviewed in the CIS 2006 wave were less likely to innovate than those in the CIS 2008 wave. Similarly, the coefficient of the 2010 wave emphasises a reduction in the probability of innovating compared with the CIS 2008 wave. However, the 2008 wave level was reached again and exceeded since the 2012 wave.

Third, the positive and statistically significant interaction term between wave and collaboration breadth in the 2010 post-crisis wave emphasises that innovation performance increases more with collaboration breadth during such a wave than it did in the 2008 wave. However, the interpretation of logistic coefficients may not always be straightforward when interaction terms are present (Brambor, Clark, and Golder 2006). Therefore, Figure 1 presents the marginal effects of wave on the probability of introducing a new-to-the-market innovation (Pr(new-to-the-market)) at different levels of collaboration breadth. The bars indicate 95% confidence intervals. The probability of innovating at any level of collaboration breadth is lower in 2006 than in 2008 (reference wave, therefore not displayed) since the line describing the 2006 wave and its error bars are always below the horizontal 0 solid line, which is the boundary between a positive effect on the probability to innovate and the negative effect. Therefore, a firm in the

2004-2006 triennium had a lower probability of innovating than one with the same level of collaboration breadth in the 2006-2008 triennium.

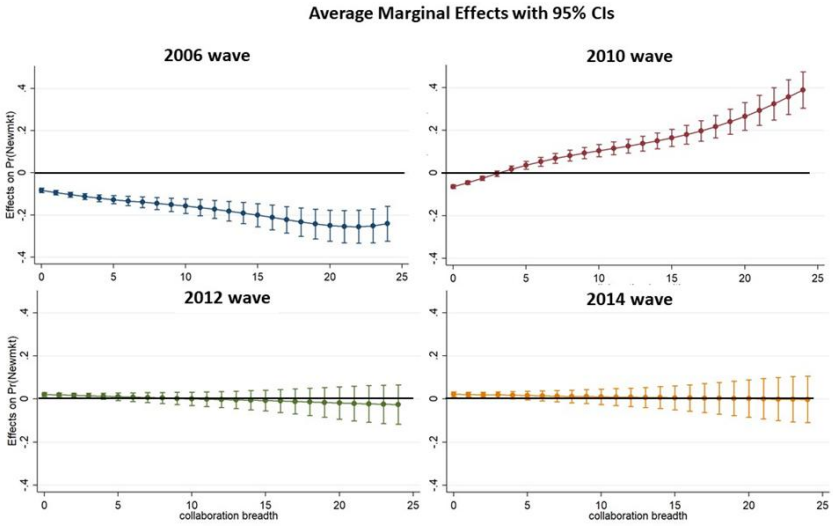

Figure 1: Average marginal effects of wave on newmkt at different levels of collaboration breadth

The curve describing the 2010 wave shows higher probabilities to introduce a new-to-the-market innovation than in the 2008 wave for values of collaboration breadth higher than 4. Instead, for levels of collaboration breadth lower than 3, the chances to achieve a new-to-the-market innovation were higher in the 2008 wave.

The subsequent waves (2012 and 2014) showed comparable marginal effects to the 2008 wave. Therefore, other factors being equal, the probability of developing a new-to-the-market innovation increases more with collaboration immediately after a crisis in highly open firms (with four or more active collaboration channels) but increases less with collaboration after a crisis in moderately open firms (with less than three active collaboration channels).

The control variables show, as expected, that larger firms, firms investing more in R&D, and firms having abandoned at least an innovation project are more likely to develop new-to-the-market innovations. Very surprisingly, the likelihood of developing new-to-the-market innovations decreases as the innovativeness of the country where the firm is based increases. The result most likely depends on newmkt being present in 24% of firms based in the innovation leader country, as

opposed to 36% in firms based in moderate innovator countries and 26% in catching-up countries.

4.1 Robustness Checks

A different specification of collaboration breadth that does not consider geographical variety (collaboration breadth redux), but only channel variety (i.e., defined in a 0-6 interval), was used to ascertain the robustness of the results. The replication of Models 1 and 2 using the collaboration breadth redux dependent variable returned the same results discussed in the original models, confirming that they do not depend on the specification of the variable. Models 1 and 2 were also replicated in two sub-samples, including service firms (i.e., NACE sections H-S) against industrial firms (i.e., NACE sections B-F). The overall results (not shown here for brevity) are substantially unchanged, with a few additional insights. Indeed, the subset of service firms did not recover the collaboration breadth reduction during the 2014 wave. Instead, in the industrial subset, collaboration breadth in the 2010 wave does not statistically significantly differ from the 2008 wave, which would suggest a stagnation rather than a reduction of collaborations. However, a reduction could be observed in the 2012 wave compared with the 2008 wave.

In order to better control for the marked differences that can exist between small and medium-sized (SMEs) and large-sized firms, Models 1 and 2 were also replicated in a subsample of large-sized firms (turnover≥€50m)1 and a subsample of SMEs (turnover<€50m). The findings show that larger firms' collaboration breadth stagnated in the 2010 wave rather than decreasing (the corresponding wave coefficient was not statistically significant) but decreased in the 2012 wave. Instead, SMEs' collaboration breadth decreased in 2010, as observed in the whole sample, but recovered already in 2012.

The replication of Models 3, 4, and 5 using collaboration breadth redux as one independent variable returns very similar results to the original models (see Figure 2).

[1] *The threshold is based on EU recommendation 2003/361*

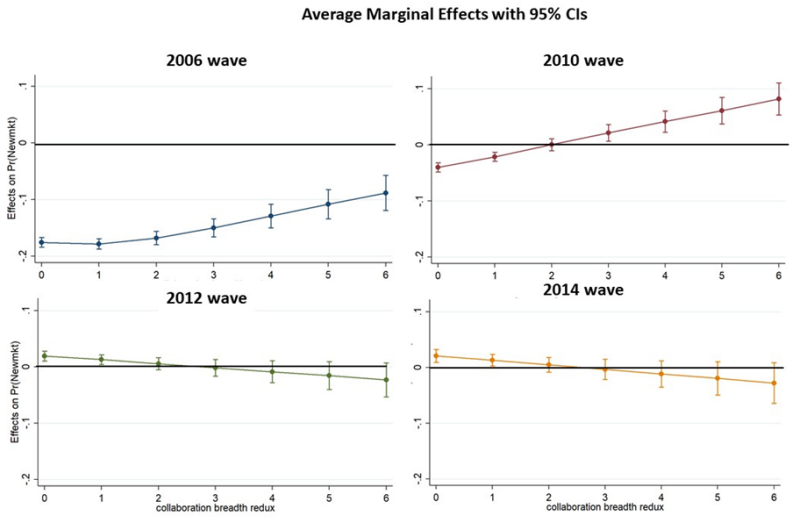

Figure 2: Average marginal effects of wave on newmkt at different levels of collaboration breadth redux

The figure suggests that, if the geographical variety is not considered, two collaboration channels are the threshold distinguishing "highly open firms", that could increase their chances to develop innovations in the aftermath of a crisis, from "moderately open firms" that were less likely to develop innovations than the firms interviewed in the 2008 wave.

Models 3-5 were also replicated in two sub-samples, including services firms against industrial firms. The findings (not shown here for brevity) are substantially unvaried, with some neglectable changes. Among them, the loss of statistical significance of the interaction term between collaboration breadth and the 2006 wave for service firms, and the loss of statistical significance of the 2012 wave coefficient for industrial firms (which means that the 2008 wave's 'innovativeness' was recovered in 2012, but not exceeded by industrial firms). As done for Models 1-2, Models 3-5 were also replicated in two sub-samples comparing large enterprises with SMEs. The difference with respect to the original models lies in the innovation performance of larger firms, which improved in the 2012 wave (as in the whole sample) but in the 2014 wave was not statistically significantly different from 2008. Instead, SME regression models perfectly mimic those of the whole sample.

Since the variable R&D intensity was missing in more than 30'000 firms, which induced the exclusion of the entire 2014 German wave and of a great amount of

information from the models under investigation, a robustness check was conducted. It was conducted by substituting R&D intensity with the rrdin item, a dummy variable describing whether the firm engaged in intramural R&D, or not. The variable is widespread across waves and countries. The replicated models confirmed all the key findings presented before, with two additions:

In the replicated Model 5, a recovery in the likelihood to innovate was achieved only in the 2014 wave (one wave later than in the original model);

In the replicated Model 5, the probability of innovating at most levels of collaboration breadth in 2012 and 2014 is larger than in 2008 (the result was not statistically significant in the original model).

As a final robustness check, Models 3, 4, and 5 were replicated using a different dependent dummy variable, new-to-the-firm, which takes the value of 1 if an innovation new-to-the-firm but not to-the-market was introduced by the firm in the last three years. The results confirmed the inverted U-shaped relationship between collaboration breadth and performance; the lengthy recovery in the likelihood to innovate after the crisis (achieved later than in the case of new-to-the-market innovations, only in the 2014 wave); the increase in the probability of innovating than in the 2008 wave for highly open firms after the crisis as opposed to moderately open ones.

5 Conclusions, implications, and limitations

This article explored the role played by the 2008 crisis on OI and innovation performance, through the analysis of a repeated cross-sectional sample of firms from 13 European countries interviewed during 5 consecutive CIS waves.

This article shows how after the crisis, European firms reduced – on average – the variety of their innovation partners. Such a loss was recovered only in the 2012-2014. Therefore, in response to the first RQ, the outburst of a crisis seems negatively associated with the propensity towards OI and, specifically, with the number of different collaboration channels exploited by a firm to innovate. Indeed, a crisis may urge firms to focus their energies on fewer collaboration channels to make the most out of them.

The findings also emphasise that the financial crisis temporarily reduced innovativeness. Interestingly, responding to the second RQ, the results show that the positive relationship between *collaboration breadth* and innovation performance is more marked in the post-crisis wave for the firms more active in

OI. This result suggests an underlying capability of recession periods to optimise OI in the firms that adapt to the new conditions, in line with Schumpeter's theory. Figure 3 summarises the findings, presents relevant implications, and suggests future research opportunities.

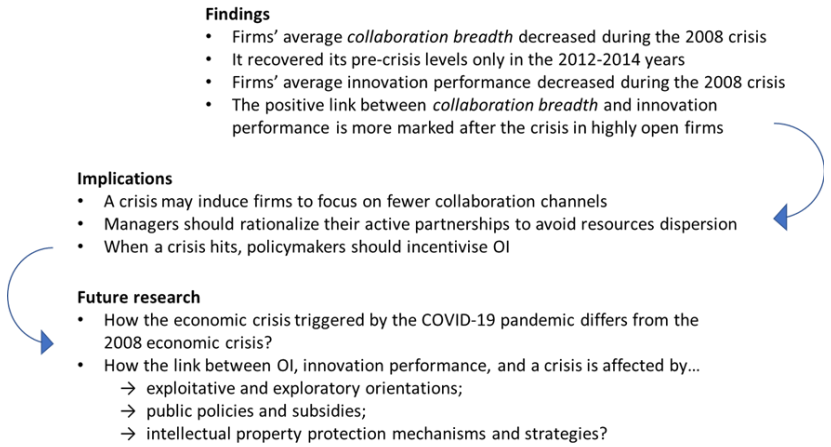

Figure 3: Findings, implications, and future research

This study is subject to some limitations. First, the need to analyse five CIS waves induced to use only those questionnaire items included in each wave and unchanged in a ten-year time horizon. This context required renouncing to other proxies for OI such as search breadth and search depth; to other measures for innovation performance such as the turnover share from innovative products; or other typical control variables (e.g., public funding, member of a group of companies, intellectual property protection mechanisms and strategies, etc.). Third, due to the same limitations of the secondary data source, the regression models could only consider one proxy for absorptive capacity, which cannot offer a complete perspective on firms' capability to absorb knowledge from their partners. Indeed, it misses – among the others – information on firms' human capital and relative absorptive capacity (Lane and Lubatkin 1998).

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Women Founders and Innovators: Technology and Intellectual Property as Success Factors on Eco-Innovative Companies

Valentina Battista

LUM Jean Monnet University
Strada Statale 100 km 18, 73125 Casamassima

Abstract

Today the role of women in entrepreneurship is assuming great value and has become one of the most relevant topics in literature. According to the latest World Bank report (2022) [1], promoting women's empowerment is essential to achieve inclusive growth, especially in sectors that pay particular attention to the environment such as eco-innovation. Women's participation in the economy can increase productivity and help build a more harmonious society. But what are the enabling cultural, social, and economic factors that make a company founded by an innovative woman a success story? This is the research question underlying this study. In particular, the analysis was conducted through the methodology of the case study, on a company operating in the eco-innovative industry and her founder. The analyzed innovative company is characterized by a business model oriented towards innovation. The importance of the topic is related to the need to identify the enabling factors that contributed to the business success of women entrepreneurs, to understand in-depth the main challenges that these women entrepreneurs faced and to highlight policy recommendations offered as key drivers for facilitating entrepreneurship. The qualitative approach allows for considering cultural, social and economic aspects in an integrated way.

Keywords – Women Entrepreneurship, Eco-innovation, Patents, Technology-Based Entrepreneurship, Success Factors

1 Introduction

Traditionally, the percentage of female entrepreneurs has been low worldwide. In recent years, the study of women entrepreneurship has experienced great growth, gaining a broad consensus among academics, and contributing above all to understanding the value of focusing on women in the economy especially in eco-innovative industries. In order to cause a tangible advance in women's representation, many jurisdictions have implemented legislative actions over the

past decades, also shifting from the presumption that gender-balanced companies result in better corporate governance and efficiency. Women entrepreneurs intensify competition through creativity and innovation and can lead to a wider range of solutions to a multiplicity of human challenges, and to more gender-inclusive product development. In this scenario intellectual property and innovation are a game changing driver not only as a measure of company's innovativeness, but also as success factors capable to attract investors in funding women led firms to move away from "gadget" technologies that fail to effectively mitigate the risk of failure. Higher ownership of patents and innovations among female business owners can improve their access to finance and help them achieve their growth aspirations and maximize revenues. From these perspectives related to the growth of women founders and innovators entrepreneurs, the research tries to investigate the factors which conduct the success of women starting from Bourdieu's non-material forms of capital theory: economic, cultural and social.

2 Methodology

In this paper, the methodology of a single case study has been used. This method is suitable for the analysis of all those complex phenomena that are difficult to standardize and operationalize. According to the qualitative research approach described by Strauss and Corbin (1990), case study methodology is selected because the borders between phenomenon and context are unclear. In particular, aimed at understanding the phenomenon in all its articulation by observing the variables and their interacting relationships, the case study becomes very useful when it is not so easy to separate the object of observation from its context and its effectiveness has been proven when research requires observation of social phenomena and their interpretation by researchers (Ryan et al., 2009). In addition, as highlighted in recent literature, case study methodology has been shown to be useful in examining dynamics and environment. A qualitative research approach was adopted because women's collaboration is important because of their delicacy in disclosing information related directly to their business circumstances, their challenges and the personal context of their entrepreneurial success factors. As Silverman (2005) already noted, the effectiveness of qualitative research includes sensitivity in choosing research tools and a flexible approach to data collection, including the art to ask questions.

Qualitative research is appropriate where samples are small. The tradition of using small studies in qualitative research depends on the need to carefully examine the nature of enterprises, or phenomena under study and ask appropriate questions related to them.

Based on empirical evidence from a single case study of an Italian woman founded eco-innovative company the paper presents a comprehensive and triple contribution consisting to a) identify social cultural and economic factors that contributed to business success of the women entrepreneurs b) understanding innovation as a key successful factor to attract investors and drives both business competitiveness and the sustainable economic growth of the companies c) identification of potential public policies to advance the research agenda.

Table 1. Phases and decisions for conducting the single case study methodology.

Phases of the case study	**Key decisions**
Identification of the research goal	*How can cultural, social and economic factors enable the business success of women founded eco-innovative firms?*
Selection of the Case	Criteria for case selection: - A female Entrepreneur and Innovator who runs an eco-innovative firm - The business should be successful or being recognized for its potential for growth. - Business model based on scientific research and innovation - Consolidated presence and participation at the local innovation ecosystem - The company has been in business for at least 4 years.
Identification of case study's boundaries	Holistic view of the phenomenon in terms of innovation capability according to a cultural social and economic dimension.
Selection of Data Sources	- Identification of the official website, and accounts on social networks (such as Facebook, LinkedIn, YouTube). - Interviews, press releases, videos, official documents made available by the company and semi-structured interviews with the entrepreneurs in person.
Analysis of Data	Triangulation of data, by combining evidences resulting from the web-based desk analysis, official reports published external agencies and observatories
Writing	Developing of the case, in terms of context, main evidences, implications for theory and practice

Moreover, the semi-structured interview method has been used with a combination of some structured questions with some unstructured exploration. The interviews with the entrepreneur and the team of the company were in person from one to four times in convenient places, for example, in the offices of interviewees or in a caffe or on Zoom. The interviews lasted from one to three hours. The purpose of the interviews was to get an idea of the woman entrepreneur, her goals and aspirations for the future and of her entrepreneurial experience to date and develop a rich picture. The case study was intended to provide an in-depth study of the two companies providing a deep understanding of the entrepreneurial processes, recognizing the strategic role of innovation and how social truths are embedded in organizations. Participants were asked to identify milestones and critical issues, considering the value of this method in entrepreneurial learning and innovation. The research method based on case studies with in-depth interviews has a good basis in their progressive and repetitive nature with synergistic effects. Qualitative methods usually employ research methods aimed at exploring and discovering "new relationships". This means building an understanding of the meaning of experiences rather than pursuing a goal testing preconceived hypotheses. Case studies are based on specific findings that can be generalized to a larger theory to establish external validation. Unlike quantitative studies, which use surveys aimed at statistical generalization to obtain external validity. A list of interview questions that have been used include: (Table I1. Interview)

Table II. Interview

FOUNDERS' PROFILE (CULTURAL FACTORS)	
Your age	20 - 29 30 - 39 40 - 49 50 -59 => 60
Your highest educational achievement.	High School Diploma Bachelor's degree Master's degree Doctoral Degree
Do you think that a higher level of education is a factor of business success? Why? Tell me your opinion.	
Field of your studies.	STEM No STEM Both
Do you consider that having a STEM education is a factor of business success. Why? Tell me your opinion.	

Do you have any academic publications?	Yes Not
Do you think that publishing academic papers is a factor of business success. Why? Tell me your opinion	
Are you an Inventor (by that meaning if you have patented an idea)?	Yes Not
Do you think that being an inventor is a factor of business success? Why? Tell me your opinion	
Did you have any previous start up experience?	Yes Not
Do you think that having previous start up experience is a factor of business success? Why? Tell me your opinion	
FOUNDERS' PROFILE (CULTURAL CAPITAL)	
Did you receive any scientific or innovation awards, honors or recognition?	Yes Not
Do you think that receiving a scientific or innovation honors or recognition award is a factor of business success? Why? Tell me your opinion.	
Did you attend management course (MBA or similar)?	Yes Not
Role within your company	CEO Founder Both
COMPANY CHARACTERISTICS	
Company age	Before 2010 2010 – 2015 2016 - 2022
Company sector	Pharmaceutical & Biotechnology Advanced materials Health Care Medical Agtech Other eco innovative sector ----------
Company location (Country Headquarter)	open
Number of employees	Only me 2 – 10 11 – 50 51 – 200 +200
% Of women in the management team	< 50% 50% > 50%

Do you think that an equal % of women in the management team is a factor of business success? Why? Tell me your opinion and experience.	
Does your Company have patents?	Yes Not
Do you think that having a Company patent portfolio is a factor of business success? Why? Tell me your opinion and experience.	
Does your Company have Technological Innovations?	Yes Not
Do you think that having Technological Innovations is a factor of business success? Why? Tell me your opinion and experience.	
ECONOMIC CAPITAL	
Company money raised	Up to 99,999 USD 100,000 – 299,999 USD 300,000 – 499,999 USD 500,000 – 999,999 USD 1,000,000 – 2,999,999 USD
Company sources of funding	Inner Circle (friends, family, own savings) Formal Capital (Angel, Accelerators and incubators, governments, seed, VC) Mixed of fund sources

INNOVATION ECOSYSTEM - SOCIAL CAPITAL	
Is your Company involved within a regional innovation ecosystem?	Yes Not
Do you consider the involvment in your regional innovation ecosystem a factor of business success? Why? Tell me your opinion and experience.	
Does your company collaborate with universities and research centers?	Yes Not
Do you consider the collaboration with universities and research centers a factor of business success? Why? Tell me your opinion and experience.	
Does your Region have effective science and technology local policies?	Yes Not
Do you consider science and technology local policies a factor of success? Why? Tell me your opinion.	
Has your company benefited from public calls for innovation promoted at regional or national level?	Yes Not
Do you consider the participation at regional or national call and tenders for research and innovation a factor of business success? Why? Tell me your opinion and experience.	
Have your Company attended accelerator and/or incubator programs?	Yes Not
Do you consider accelerator and/or incubator programs a factor of success? Why? Tell me your opinion and experience.	

ABOUT YOUR BUSINESS
Why did you start your business?
"A business model describes the rationale of how an organization creates, delivers, and captures value." What Is Your Business Model and how do you create value?
What are the most important challenges you have faced in your business?
In your opinion, what are the success factors that have led investors to fund your business?
If you are currently doing fundraising, what are the most important challenges you are facing?
Tell me the 3 main challenges have you faced as a woman entrepreneur?
What are the barriers challenges of female entrepreneurship practice? Tell me your opinion and your experience.

3 Research context

The empirical context of the research has been identified into an Italian Smes company operating in the advanced materials sector: MATERIAS. The company operates into the eco-innovative industry.

Materias is an innovative company born in 2016 aiming to create new businesses, supporting the development of eco-innovative solutions in the advanced materials sector and accelerating their market entry. Materias invests in material based new ventures supporting the most promising technologies to overcome the "Death Valley", through the connection of the research world with industrial companies.

4 Data collection and analysis

The data for this study was collected using various sources, especially official sources such as the company's website and accounts on the main social networks. In addition, company interviews and reports were also analysed. Interviews from the team and the co-founder of the company were also considered. The method used for the analysis is multidimensional one deriving from the in-depth analysis of the literature. This methodology has favored the collection of information in terms of cultural, economic and social enabling factors. Data analysis has been extended through an inductive process (Miles & Huberman, 1984; Strauss & Corbin, 1990). The data was compiled before the analysis. This has led to an activity of categorization and contextualization of the collected data. As suggested by Weber (1990), a coding process was adopted in order to analyze the content of the analysis and identify the most useful information for an effective understanding of the case. In this study the researcher has categorized

the interview data into four sectors - cultural factors, social factors, economic factors, and business characteristics of the firm. Moreover, has been labeled each theme and identified direct quotes from the interviews, which are relevant to each theme.

5 Findings

The analysis of the case study relating to the cultural, social and economic factors that led to the success of the analyzed company. Specific parameters have been adopted that have been highlighted in the literature regarding the understanding of the observed cases. The main evidence that has been collected is in terms profile of the woman founder and innovator, the mission and main objectives of the company, cultural enablers in particular entrepreneurs and social enablers of the innovation ecosystem in which it fits and in particular the business model aimed at creating value was highlighted.

5.1. Profile of a Woman Entrepreneur

Caterina Meglio, Founder and Chief Operating Officer of Materias, an innovative materials-based SME that deals with the enhancement of research and innovation results through technology scouting, intellectual property management and the acceleration of innovation. Graduated in law with a Master in Business Administration (MBA). As an expert in innovation and cultural management, she has been President of the Conference of Presidents of the National Conservatories of Music and has directed the State Conservatory of music of Benevento. She is a member of the Board of Directors, as an expert of the Italian Ministry of Education, University and Research (MIUR) of the National Drama Academy "Silvio D'Amico". Since 2018 she has been a member of the strategic committee of the COTEC Foundation and has been the technological Manager for the Institute for Technologies Applied to Cultural Heritage (ITABC) of the National Research Council.

5.2. Company mission and cultural social and economic factors

About the mission and main objective of Materias, the official webpage synthetizes the vision as follows: “Ideas come to life for a sustainable word”. Its approach is designed to follow the whole “value chain” of the development of

new ideas from its early stages to its transformation in market-ready solution. In particular, Materias supports inventors and investors in choosing which project has the potential to be successfully transferred to the market. Moreover, one of the best innovation strategies of Materias is the opportunity to introduce new technologies into products by cross-fertilizing researches and scientific results. This approach is also a direct consequence of the objective of Materias to create a bridge that connects research and industry. In order to achieve its mission, Materias has identified i three-fold activities: Scouting, InComing, Acceleration. - Scouting: Materias performs the identification, screening and evaluation of innovative ideas generated by the academic sector and the research world. The scope of this phase is to collect in a database, which represents a strategic asset for Materias, the most interesting and promising ideas available on the Italian and European scenarios in the Advanced Materials sector. In particular, Materias will focus its attention on deep-tech innovations, i.e. those technologies based on tangible engineering innovation or hard scientific advances and discoveries that can create disruptive solutions that redefine markets and industry processes. (https://www.materias.it/it/mission.html)

About the business innovation model Caterina Meglio said during the interview created for this study that "Innovations generally need highest investments to reach the market, in order to assess and validate the idea. - InCoMing: Incubation, Coworking and Merging: the second step of Materias value generation model foresees the development of the idea through technical-scientific assessments, technology validations, patent analysis, knowledge integration and cross-fertilization. In order to develop the technology on which the idea is based, Materias will involve experts from Universities and Research Centers which belong to its innovation ecosystem. - Acceleration: the third step of Materias value generation model foresees the creation of a market-ready solution through the development of a customized business model or the launch of a dedicated startup able to tackle the market needs. This step is carried out in collaboration with financial or corporate investors (interview 15 November 2022).

About social enablers factors, in this study, the innovation ecosystem of the Campania Region has been considered fundamental in terms of identifying the success factors. As Caterina Meglio has underlined during the interview: "thanks to the local efficient innovation ecosystem we collaborate with universities, research centers, companies, and institutions. For us playing an active role in this innovation context, represents a crucial crossroad relevant to establish strong

relations with industrial and institutional investors as well. Furthermore, with reference to the technology process, Materias work with professional players with expertise in the Intellectual Property management. Moreover, in order to develop our activities, we have created our innovation ecosystem that has allowed us to come into contact with excellent public and private research Centers of international relevance. The entire ecosystem has generated a valuable contribution in terms of technology transfer and first industrialization" (interview 15 November 2022).

Campania is the first region in the South by contribution to the value added of the manufacturing sector (33.8 percent of the total) and the estimated change in manufacturing value added between 2017 and 2021 is +10.9 percent, 1.7 p.p. more than the Italian average (+9.2 percent) (The European House - Ambrosetti on Istat data, 2022). According to the Regional Councilor of Research and Innovation, Valeria Fascione, the objectives of the Campania innovation ecosystem for the period 2021-2027 are: strengthening and enhancing the research and innovation system for green and digital transitions, stimulating the diffusion of innovation in Campania's business and promoting openness and exchange toward national and international partnerships and collaborations (open innovation) (article http://ris3.regione.campania.it/index.php/news/notizie/660-innovazione-valeria-fascione-il-capitale-umano-al-centro-del-pnr-2021-27). Moreover, there is a strong cooperation between all the major players in the innovation ecosystem in Napoli and Campania.

As Caterina Meglio has underlined: "Materias has participated to the initiatives adopted in the last 5 years by the Campania Regional Government to support R&D, Innovation and Startup creation. These activities have been designed through the active involvement of Industry and Business associations: Confindustria Campania, ConfAPI, Camere di Commercio and ConfArtigianato. This participatory process is a great opportunity and it is regularly implemented through public consultations, open forums, stakeholders' meetings that involve hundreds of representatives from Industry, Academia and Public Bodies." (Interview 15 November 2022)

The innovation ecosystem is composed by 7 universities, 40 advanced research centers active in technology transfer and innovation services and the largest researcher community in Italy of the CNR (National Research Council) with 16 main offices and 8 secondary ones. According to the Councilor Valeria Fascione "the innovation ecosystem has 7 High-Tech Districts and 30 structures to support

entrepreneurship"(incubators, science and technology parks, Fab lab, accelerators and service centers) (http://www.campaniacompetitiva.it/).

In terms of economic capital, Materias has raised more than 5.5 million in funds and among its shareholders are Intesa San Paolo, Ibsa Group and Dompé Holdings. (https://www.volanogroup.com/venture-capital-al-sud-solo-il-4-degli-investimenti/). As outlined by his President Luigi Nicolais "This is because Materias has invested and produced innovation which, according to the literature and as highlighted in this study, represents a factor of success. Our company operates on scientific knowledge-based technologies, which require more costs and risks than digital innovations. The work carried out in the first six years of activities has allowed the scouting of over 1100 ideas in the advanced materials sector, going from life science, civil engineering, food-tech to industrial engineering. Our force is represented by the patents of the company and its technologies in portfolio". (article https://www.politicameridionalista.com/ 2021/04/22/intervista-allo-scienziato-luigi-nicolais/).

As pointed out by Caterina Meglio during the interview: "Companies led by women have to demonstrate more than those led by men. Having the ability to produce innovation through patents and technologies is a fundamental value and a critical success factor which has allowed us to be recognized as a point of reference in the field of advanced materials and to receive funds not only from institutional investors but also from large companies. Materias today has 80 proprietary patents with international extension belonging to 20 patent families and we have created technological platforms and financed research projects through its own funds. Materias in addition have funded three startups: Etesias, which aims to innovate the construction sector by reducing the environmental impact and increasing efficiency with the 3D printing of prefabricated reinforced concrete elements. Sanidrink based on a technology for the functionalization of tubular ducts using antimicrobial peptides for food and medical use. AMPure, a start-up that has develop a biomaterial against acne. Materias has offices and laboratories in Naples and Bari." (Interview 15 November 2022).

Extremely rich of evidence is the aspect related to cultural factors. One of main cultural evidence is that the founder of Materias, Caterina Meglio has a strong academic and managerial background. And to the question whether a high level of education has helped her in the development and growth of the company she said that:" having an MBA and also a relevant professional career with has been for me an important starting point for the startup of my company. For these

reasons, my team is made up of more than 70% professional women, highly qualified and well-respected experts from the technical-scientific, legal, and managerial world with numerous experiences in the field of innovation, scientific research and intellectual property". (Interview 20 November 2022).

Likewise, regarding the cultural factors relevant are the awards and publications in the field of research and innovation. Materias has won several awards for its activity, showing itself as an excellence. Among the prizes won, the recent one received by the newspaper Il Mattino. (https://www.ildenaro.it/caterina-meglio-materias-premiata-per-i-130-anni-del-mattino/) and (https://onlinelibrary.wiley.com/ doi/full/10.1002/app.52052).

6 Discussion

The case study has revealed the social economic and cultural enablers which impact to women entrepreneurial success in eco-innovative companies. Women founders and innovators are bravely entered in a field dominated by male-led firms generally, demonstrating that they can tap into the shifting technological landscape and actively use its tools for economic and social advancement. According to the literature, women's entrepreneurship in tech field is still a relatively new phenomenon. The analysis of Materias provides the prospects for several contributions for the improvement of the academic debate related to women in technology-based entrepreneurship. Focusing on the evidence resulting from the study, it confirms the relevance of social factors like the innovation ecosystem and the social network based on universities and research centers. The importance of the innovation ecosystem of the Campana Region and its policy strategies highlighted in the study should not be underestimated. In fact, the environment in which Materias grows and develops is attractive and stimulating and allows the growth of entrepreneurship. In fact, women founded companies with patents and technologies have the opportunity to catch the attention of Venture Capitals and Public institutions in order to raise funds thanks also to an open innovation and sustainability strategy. Starting from its mission oriented towards innovation, the case of Materias highlights the importance reserved to patents and technologies, supporting the recent debate considering these intangible and "disruptive" assets for value co-creation. This is supported by the evidence about the academic and professional background of the woman founder and CEO, Caterina Meglio and its team, top women managers, and

directional staff into the eco-innovative sector. Such evidence contributes to the debate in the academic and managerial field on women entrepreneurship in innovation and to highlight the best practice in order to identify which enables factor should be taken in consideration.

7 Conclusions

The analysis of the case allowed to identify the enabler factors characterizing the business success in women founded technology-based company and their strategy. A set of specific features have been identified through the analysis of Materias case. Organized around a multidimensional framework, the analysis of the case has allowed to identify the specific factors behind the woman founder and company organization according to Bourdieu theory of capital framework, into the eco-innovative industry. An emerging research trend in literature is whether the presence of women in leadership positions affects the competitiveness advantage through innovation. Several scholars studied women-controlled firms and deduced that social and cultural factors and entrepreneurial skills have a positive impact on enterprise innovation. Moreover, the innovativeness of the firms has significant impact on the competitive advantage of companies considered as success factor. Furthermore, Adam et al. according to study on woman entrepreneurs in Egypt reported that innovation positively influence competitive advantage. The literature concerning women entrepreneurship has its focus on identifying the characteristics and problems faced by women entrepreneurs. There is significant need to perform empirical investigations that connect the performance of women entrepreneurs with their characteristics and with other factors related to the entrepreneurial world. To answer to this question, the findings of this qualitative case study, have showed the positive association of different types of factors as classified by Bourdieu (1986) with the successful performance in terms of innovation of ventures that are owned by women entrepreneurs in the eco-innovative sector. Further research should focus on traditional sectors to understand whether women entrepreneurs in technology-based companies and traditional sectors both are affected by similar factors. According to this perspective, more effective and strategic public policies can be developed to improve women entrepreneurship.

7.1. Implications for theory and practice

The importance of the study lies in the relevance of the topics for both theory and practice, as well as in the contextualizing contribution offered by the research. This study has analyzed a company that makes innovation the center of its business and its success factor capable of attracting investors. Specific elements of originality are identifiable into the business model of the company based on innovation and could represent a best practice to stimulate new policies and suggestions and promote women empowerment.

A further element of original value consists into the exploration of the social factors related to the regional innovation ecosystem with its networks, its strategic research and innovation policies and specific programs which are given a great contribution to the achievement of grand challenges in term of business development. Finally, the case study analysis of the Italian eco-innovative company operating in the advanced materials sector provides interesting evidence for this research goals offering elements for future speculation both in theory and practice. The company analyzed considers intellectual property a success factor for its growth. Indeed, as also confirmed in the literature, this case study demonstrates how the protection of intellectual property has helped the company headed by a woman to find partners, secure financing and commercialize the inventions. Finding investors and forming partnerships especially in women-led companies is not easy, but often the ownership of intellectual property rights on a technology or product, especially for technology-oriented companies or start-ups is relevant. Furthermore, patents are an intangible asset that confers greater market value among established firms. In general, according to statistics, women are engaged in the field of intellectual property less than men. Therefore, this case study could enhance policy makers to provide policies for a significant involvement of women-owned companies in intellectual property.

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What Do the Faculty Members Know: A Multidimensional Knowledge Portrait

Tatiana Gavrilova[1]

Graduate School of Management
St. Petersburg State University
7/9 Universitetskaya nab., St.Petersburg, Russia

Olga Alkanova[2]

Graduate School of Management
St. Petersburg State University
7/9 Universitetskaya nab., St.Petersburg, Russia

Anna Kuznetsova*

Graduate School of Management
St. Petersburg State University
7/9 Universitetskaya nab., St.Petersburg, Russia

* *Corresponding author*

Abstract

Information overload is putting pressure on organisations to provide a better-quality service and improve agility. The key challenges for knowledge intensive organisations are how to identify, map, assimilate, disseminate, and apply knowledge, particularly the knowledge mapping of different users with incompatible perspectives and purposes. As part of this study we started the development of ontology based knowledge map which reflects faculty knowledge and delivers knowledge to various users with different perspectives and purposes. The faculty knowledge map is based on the triad of faculty activities: teaching, research and consulting.

As there is no methodology for faculty knowledge map development the paper focuses on the methods of developing such digital knowledge maps, forming a multidimensional knowledge portrait module that can be later integrated into knowledge management systems. Methods of ontology engineering are used for developing the conceptual models of the knowledge domain and faculty activities.

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Keywords – knowledge models, knowledge maps, ontologies, knowledge management

Paper type – Academic Research Paper

1 Introduction

Nowadays, dynamic technologies development and information overload effects the way people manage with complex information in educational organizations. It is a challenging experience to universities and other educational organizations to produce the knowledge intensive services desired by their customers. Knowledge mapping gives an opportunity to develop efficient and effective use of an organisation's knowledge base.

The paper presents the approach to the visual mapping of the university teacher knowledge for better communication and co-operation in research and teaching. The study is focused on the development of faculty knowledge map based on the triad of faculty activities: teaching, research and consulting.

The paper discusses the methods used for the development of digital maps, forming a multidimensional knowledge portrait module of faculty that can be integrated into the university knowledge management systems.

2 Faculty Knowledge Map

Knowledge map is a powerful information visualization technique that allows connecting experts, accessing knowledge over time, identifying knowledge assets, existing knowledge resources and knowledge gaps (Faisal et al., 2019). The main tools that are most widely used in knowledge mapping, require the participation of both experts and analysts. Knowledge maps are closely related to competency maps and employee competency management, which are denoted as skills and competencies in corporate decisions.

The basis for the study of knowledge maps was laid by such authoritative researchers in the field of knowledge management as Wexler, Leibovitz, and also Davenport and Prusak. However, neither at the initial stage, nor now there is no consensus on the boundaries of the application of this tool and the key tasks to be solved. If the first author noted the strategic importance of a knowledge map for the firm's competitive advantage (Wexler, 2001), second focused on the analysis of gaps in knowledge and their filling (Liebowitz et al. 20000, the latter

considered knowledge map as a navigator while looking for the right specialist (Davenport, Prusak 1998). Over time, the amount of approaches and competing points of view only multiplied (Kudryavtsev, et al., 2922).

Technologies for working with employees' competencies are now actively developing, their review is given in the publications of the famous analyst Josh Bersin (Bersin, 2020) about the SkillTech market. According to the APQC study (APQC 2021), more than 70% of companies consider the knowledge map a priority tool for managing intellectual resources in an environment of instability and business transformation. APQC has great experience in consulting in the field of knowledge management and knowledge maps.

At the moment, research in knowledge maps typology development covers a wide range of knowledge-intensive areas: from construction (Wang, Cheng 2022) to artificial intelligence (Corea, 2019). Particular attention is paid to the knowledge maps of educational institutions and research teams (Hellström, Husted 2004; Saurabh, Sairam 2013; Sadeghi, Alireza, 2019), since in this area there is no business-specific desire to protect knowledge from transfer and reproduction. Recently there has been a trend towards convergence of research in the field of university knowledge maps and library sciences (Deng 2019) and the integration of maps into the digital learning process (Flanagan et al. 2019).

Several methodologies with knowledge maps structure and templates are proposed (Harper, Trees, 2018). However, at the moment there is no methodology to develop faculty knowledge maps integrating the triad of faculty activities: teaching, research and consulting. Therefore, the paper focuses on the methods of developing such digital maps, forming a multidimensional knowledge portrait module that can be later integrated into knowledge management systems.

The methodology is based on the interdisciplinary framework including traditional polls and questionnaires for data collection and ontology engineering for developing the conceptual models of domains and activities. Existing templates and examples of knowledge maps structure and templates are analysed. Ontologies help to present and structure professional knowledge as systemic hierarchical graphs. Some domain ontologies use the refined and customized SCOPUS / ASJC classifications of subject areas. In-depth interviews with faculty members are carried for empirical validation of the developed ontologies.

Methods of ontology engineering have been widely developed for almost 30 years, starting with the pioneering work of Gruber and Uschold (Gruber, 1993; Uschold, 1998) to the present (Holsapple & Joshi, 2002; Human, 2017; Patel & Jain, 2018; Krieg-Brückner, Mossakowski & Codescu, 2021).

The number of steps of such methodologies used for building enterprise and/or conceptual knowledge maps varies from 3 to 11, depending on the degree of detail of each development phase. While the methodologies have different number of such steps, they use basic stages which include identification of the scope, domain of knowledge map and the develop team, of the knowledge resources or materials, of the knowledge in each knowledge item, building knowledge map, evaluation, use, and further knowledge map development.

Based on the analysis, summarizing it and our experience, we have proposed the novel methodology from 4 stages called it ONE-VID: Set of ontologies design (ON); Knowledge elicitation for ontology population (E); Visual knowledge mapping (VI); Knowledge map justification and dissemination (D).

The first stage of the methodology (ON) is focused on the development of a set of ontologies defining the conceptual structure of the future map. Our task was to create an ontology providing a big picture view of the teacher's activities at the university in the domain of management studies. Fig. 1 presents a simplified top-level ontology describing the work of a teacher. The duties of every faculty member include doing teaching, research and some applied work.

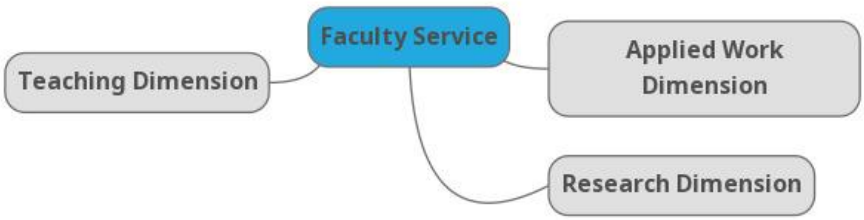

Fig. 1. A simplified top-level ontology of the teacher's knowledge

Each of the concepts of this ontology consists of a number of detailed pieces that are shown in figures 2, 3 and 4. These figures were developed in Protégé and present the ontologies of each of the three areas of the teacher's service at the university.

Fig. 2 shows the ontology for the domain of teaching.



Fig. 2. Ontology of the teacher's knowledge: teaching

Ontology for teaching includes the following forms of activities: in-class (courses); out-of-the-class (supervision), publications of teaching materials and various types of teaching expertise dissemination; as well as levels of programs (bachelor/master, doctoral, executive and corporate), and types of involvement (course renewal, new course development, new training or business simulation development).

Fig. 3 shows ontology for the teacher's knowledge in applied work covering consulting services and different activities in the field of mass media.

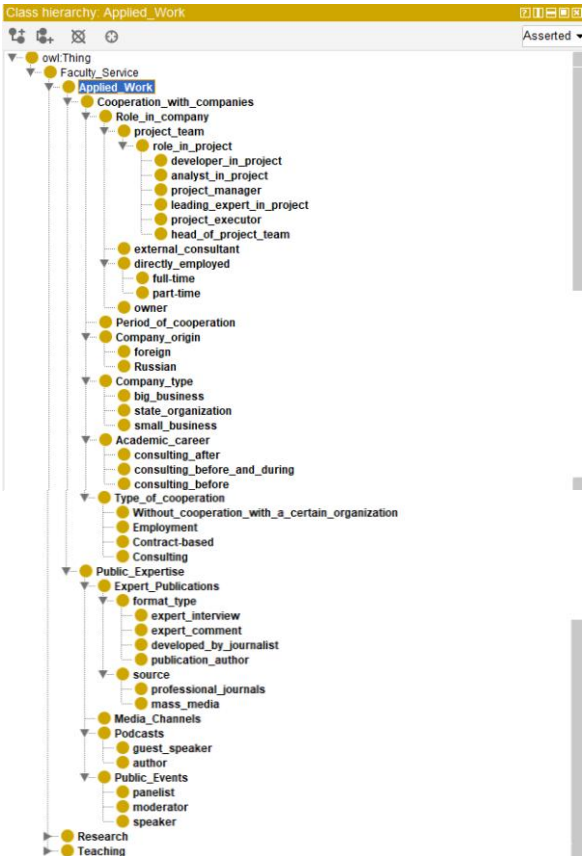

Fig. 3. Ontology of the teacher's knowledge: consulting and media

In terms of consulting this part of the ontology includes information about the duration of cooperation with companies and the link to the faculty's academic career, information about the company, type of cooperation and roles in consulting projects. Public expertise is presented by expert publications in

professional journals and mass media, podcasts and media channels as well as during public events where the teacher could participate as a speaker, panelist or moderator.

Fig. 4 shows ontology for the teacher's knowledge in research.

Ontology for the research activities presents research projects and events, publications and expert service in research domain.

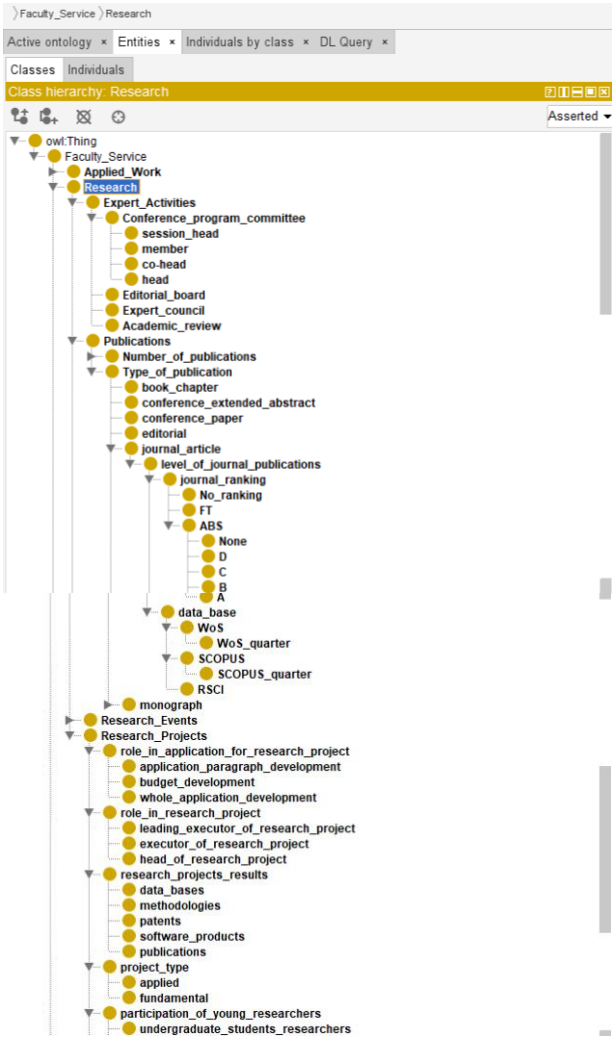



Fig. 4. Ontology of the teacher's knowledge: research

Research domain ontology includes detailed information on the types of projects (projects with external funding from research foundations, projects with external funding from industry, projects with internal funding from the universities), roles in applications for the projects and in the projects (head, executor, leading executor), types of project outcomes (e.g., theoretical models, analytical reports, research methodology, management methodology, etc.);

On the basis of the developed ontology, at the second stage (E) of our methodology the questionnaire was developed, and specific data collected.

Now we are at the stage of data analysis and the selection of metaphors and visualization (VI) which will be followed by knowledge map justification and dissemination (D). Fig. 4 illustrates some preliminary knowledge maps.

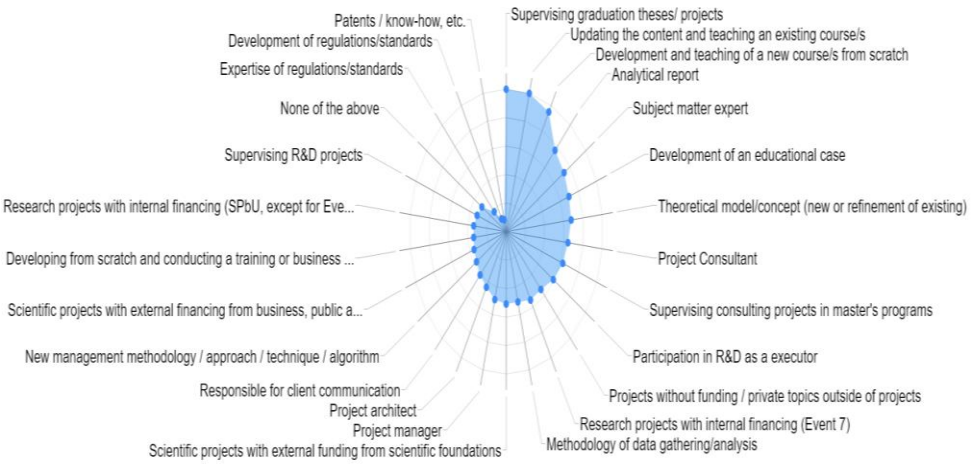

Fig.4. Radar Chart of Areas of Activities among Professors

Analysis of this figure shows that major of the faculty have bias to teaching and research activity. And less of them were involved in consulting and practical projects. By using a radar chart, it becomes easy to compare the level of experience of professors in different areas. For instance, it's clear that more professors have experience in supervising graduation theses/projects than in analytical reporting, as shown by the wider radius of the axis corresponding to the former.

The chart also highlights areas where there is a lack of experience among professors. For instance, the area with the least number of professors having experience is patents/know-how. This can help the department identify areas where they may need to attract more experienced faculty members to enhance their expertise in certain domains.

The radar chart provides a bird's-eye view of the overall distribution of professors' experience across different areas. This can be useful for departmental management to gain insights into the department's strengths and weaknesses and plan their recruitment, resource allocation, and development strategies accordingly.

3 Conclusions

Academics are focused on the efficient use of collective intellectual assets. Our approach helps to create such asset in the form of simple and clear map which presents a multidimensional knowledge portrait of teachers and researchers. These individual portraits may be integrated into the collective portrait of the department or the school in general. We propose a four-stage methodology that is aimed at extracting, structuring and formalizing the knowledge of members of education and research academic teams to improve the quality of scientific communications and information exchange. At the moment the first two stages of the methodology are completed: ontology is developed, the data is collected. Further work will be focused on the third and fourth stages devoted to the selection of metaphors, dashboard development followed by knowledge map justification and dissemination (D).

Such a faculty knowledge map is valued as both organisational intellectual capital and a source of competitive advantage as it provides a visual orientation for managers or experts who wish to locate, evaluate or develop knowledge in an

organizational context. It could be used to establish the flow of the internal and external information in order to increase the efficiency of creativity and invention.

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Disruption in Research Practice - Disruptiveness in New Knowledge Spaces

Paul Raphael Stadelhofer*

WISSENSARCHITEKTUR - Laboratory of Knowledge Architecture
Technische Universität Dresden
01069 Dresden

Anja Jannack

WISSENSARCHITEKTUR - Laboratory of Knowledge Architecture
Technische Universität Dresden
01069 Dresden

* *Corresponding author*

Abstract

Disruptive innovation has become a hype in some industries, discourses and applied research fields and often has a positive connotation. This normative conception of disruptive innovation often arises from the context of sustainable development: outside existing systems and structures, new solutions for mitigating and adapting to climate change are to be sought. Ethical reflection is of particular importance. (IPCC, 2014).
The paper, therefore, argues that a critical examination and definition of the disruption concept are pending. This means that it should be examined how the term is used in such a way that it is linked to normative expectations of research and innovation processes. Based on this, it is argued that disruptiveness cannot easily be invoked in research projects as a legitimising approach to positive social consequences of development processes. The concept of disruption is therefore related to changing knowledge spaces in research and innovation processes. By changing social interactions in socio-technical systems, reference systems for research and development processes are altered and dynamics are disrupted. Starting from the discussion of various possible definitions, the legitimacy of the demand for disruption in research practice is critically questioned. Thus, it is less a matter of radical change happening through external force, but rather of disruptive research or innovation being actively pursued
Some problems with disruption are outlined in the introduction. The resulting questions are formulated in the first section. Some approaches and possible goals in modelling disruptive innovation are discussed in the second section. Finally, the state of the research and conclusions are discussed.

The overarching question for the contribution is: "What is the significance of the concepts of disruption and disruptivity for the practice of responsible research and innovation, taking into account the technical shaping of new knowledge spaces"?

Keywords – disruption, paradigm, path development, innovation, knowledge management

Paper type – Academic Research Paper

1 Introduction

Where does the enthusiasm for disruptions come from and how can the concept of disruption be normatively justified? This is our introductory question. After all, disruption is sometimes negotiated in research programmes as if it had a high intrinsic value without further ado. An important incentive for the enthusiasm for disruptive innovation arises on the one hand from the growing criticism of "business as usual" in the sustainability discourse. On the other hand, it is observed in the trend towards digitalisation that radical changes are occurring in established social interactions, that new expectations of social interactions are emerging in technological change, and that the fundamental transformation of discourse and knowledge spaces in just one generation has also created fundamentally new starting conditions for future developments. This creeping change can be understood as a "progress" whose dynamics, shape and consequences have developed largely independently of the research goals in academia. Thus, new digital devices such as wearables and everyday apps, new knowledge spaces and new dynamics of technology development as well as knowledge production have emerged. A linear concept of progress, which understands the current state of science as the last result of a long chain of consecutive developments, seems neither viable for capturing these dynamics nor for concretising the concept of disruption. Subsequently, it is argued that it must be critically questioned what role disruption and disruptiveness play in cutting-edge academic research on the one hand and in innovation networks on the other. In other words, is "disruptive research" really being done, are structures being changed and institutionalised practices as well as hierarchies being broken through, or is this happening in non-university development after all?

2 On the question of disruption

Observing the debate on disruption, the first question that arises is why disruption has become a trendy word in recent years and often has a positive connotation.

So the question is, firstly, where does the positive expectation of radical change come from, i.e. how is it justified, and secondly, how is such a change thought of as a plausible development, i.e. whether it can be evidently anticipated?

Since such a development is also linked to technical as well as scientific knowledge and developments, this raises the question of the meaning of disruption and the currently heterogeneous concepts of disruption in research practice. At first glance, different understandings of disruption seem to be at work. So how do these influence scientific practice?

Disruptive developments have an impact on science by shaping the space of scientific knowledge production and also by changing the demands on and dynamics of scientific developments. For example, online databases and events have changed the exchange between scholars, the possibilities of science management have changed in the course of digitisation, new forms of visualisation have emerged and the use of digital technology has become a prerequisite for setting content priorities in research as well as teaching in almost all fields. Using a clearly defined concept of disruption could lead to sustainable approaches to coupling research in the humanities and social sciences on the one hand and engineering and natural sciences on the other. The focus of the question of disruption in research practice thus touches on science-theoretical and ethical aspects concerning specific research practice.

Since the development of technical solutions is brought to the fore, especially in "innovative" projects, the discussion of disruptive developments should be assigned to technology assessment. A current focus in the context of technology assessment is on the question of what role the concept of disruption plays in responsible research and development, And what normative connotations come into play regarding societal impacts. (PROSO Consortium, 2018; A. (KIT/ITAS) Grunwald, 2019) The relevance of this stems from the role of disruption and disruptiveness in research practice. The focus is then not only on the outcome of development projects but also on their structure and dynamics, as examined in meta-studies on funding and research programmes, such as the German Excellence Initiative. (Hornbostel, Simon and Heise, 2008; Möller et al., 2012;

Hornborstel and Möller, 2015; Neumann, 2015) A rough value-based framework is outlined below.

It follows that addressing the notion and concept of disruptive research could be accommodated in recent approaches from innovation research, such as the concept of co-creation and open innovation. The overarching question for us in addressing disruptive research is: "What is the significance of the concepts of disruption and disruptiveness, taking into account technically shaped knowledge spaces, for the practice of responsible research and innovation?" In other words, the question is how routines, subject cultures and knowledge spaces are also changed in the context of disruptive research: "How do innovation networks outside academia fare? What dynamics shape these networks and how can the changing interaction of heterogeneous fields of development be classified into knowledge spaces? How are these heterogeneous knowledge spaces structured and where are potentials? What approaches arise from this for the development of new research projects?"

Answering these overarching questions on an abstract level requires addressing various sub-questions:

1. What does disruption mean, i.e. with which premises is the term connoted positively or negatively? On which approaches to describing and reflecting socio-technical change or scientific development can the term be concretised and how does the understanding of disruption or disruptiveness change through underlying concepts such as transformation, innovation, paradigm shift, scientific revolutions or in the development of new and emerging strategic technologies, breakthrough technologies and basic innovations? These concepts and their meaning, if adopted as frames of reference for the concept of disruption, are outlined below.
2. How is the term systematically classified and questioned by researchers? In the foreground is the question a) To which reference systems can the concept be specifically directed in academic research? For example, this could mean either structural changes in research institutions or the impact of research results when they lead to product innovations and business start-ups.

Furthermore, the question b) What role do knowledge spaces and the interaction of different professional cultures play in the development of disruptive innovations? For example, new media could change collaboration between

disciplines. New processes and responsibilities could also be institutionalised and change current practices.

This also raises the question c) What is the structure or what are the characteristics of the interaction of different disciplines concerning multi-, cross-, inter- and transdisciplinarity? For example, research projects can be characterised by a juxtaposition of different disciplines without the premises of their work being questioned. However, there can also be a deeper reflection on the methods and questions used, so that new subject areas emerge.

Finally, this raises the question of which normative ideas are used to legitimise disruptive research projects. That is, how are moral goals from engineering science projects negotiated in the humanities? What are the ethical problems in disruptive developments?

When these fundamental questions about disruption and disruptiveness in research practice are examined, further research questions arise: What limits arise for the elaboration of new inter- and transdisciplinary research approaches (methodological, spatial, temporal, organisational, structural, cultural and cognitive)? How does the concept of disruption relate to the historical development of the university into a research institution with third-party funding and an entrepreneurial orientation?

3 Perception and justification of disruptive developments

3.1 On the perception of disruptive developments

In the course of digitisation processes, the change in social routines and human-technology interaction makes the change in existing practices intuitively clear and comprehensible. A tangible example of this is the displacement of earlier data carriers such as CDs, floppy disks or punch cards, the displacement of readers for such data carriers, the spread and standardisation of new protocols for online communication as well as the emergence of new routines and frameworks, in combination with the expiry of support for "obsolete" software and devices, make it possible to experience a radical change. Particularly concerning digitalisation, there is very frequent talk of disruptive innovation. This process simultaneously refers to disruption as a social process and raises ethical questions about technical developments that cannot be answered with existing "customs". Ever faster innovation cycles that make existing infrastructures,

routines and institutions obsolete, new forms of work without social security models developed in the long term and ever more far-reaching possibilities of individual changes are developed as means for a leap into the unknown. (A. Grunwald, 2019)

Technical possibilities shape people as individuals, they shape forms of and expectations of social interactions, and they also shape the image of people, although this is usually not morally intended or ethically legitimised.

A normative conception of disruptive innovation, on the other hand, arises from the context of sustainable development: outside of existing systems and structures, new solutions are to be sought to mitigate and adapt to climate change and ensure human survival. There are many examples in this context. The following statement by the Intergovernmental Panel on Climate Change from its 2014 Synthesis Report is representative of this:

> "*Restricting adaptation responses to incremental changes to existing systems and structures, without considering transformational change, may increase costs and losses and miss opportunities.*" *(IPCC,2014, p20)*

It is thus about a deliberative search, a normative claim for change. It relates, among other things, to infrastructures, new paradigms of development, technologies or practices, the formation of new financial structures or governance systems and the development of higher demands on the structures of political governance, to name just a few examples of ethical relevance. Change is implemented through iterative learning, deliberative processes and innovation. (IPCC, 2014) This scope of transformative change makes it necessary to give special importance to ethical reflection in the study of disruption. Without an ethical justification, such a far-reaching change as the one in question could not be legitimised. The normative demand is based on scientific findings, but in the weighing of possible measures and consequences, it represents an ethical object of investigation when, in addition to new governmental systems and financial structures, changes in development paradigms as well as practices are in the realm of possibilities.

These problems gain their contour through two opposing perspectives on the social embeddedness of research and development as well as on the social impacts of disruptive innovations: (1) on the one hand, the meaning of the term disruption in academic, third-party-funded cutting-edge research. Here, the prospect of fundamental change and disruptive research results is sometimes cited as a legitimising approach for basic research in engineering and the natural

sciences. Social and institutionalised systems of action have a dominant effect here on the dynamics of knowledge production. At first glance, however, less attention seems to be paid to bottom-up synergies. From a different perspective, these are in the foreground: (2) Grassroots innovations as well as innovation networks, which make a significant contribution to technical change partly within institutions, but above all also outside academic practice through social innovations, i.e. the technology-supported change of social interactions. Here, the focus is often on repurposing and recombining existing basic innovations, new forms of social interaction are tried out and networks are formed. This leads to a restructuring of the dynamics of knowledge production, new knowledge spaces emerge and, as a consequence, the disruption of established routines and practices can be observed.

Both of the observable dynamics are reflected in all technical and scientific developments. How they can be related to each other is therefore discussed below.

From the comparison of the poles mentioned, a picture emerges of the dynamics of knowledge production on a systemic as well as synergetic level based on changing knowledge spaces and thus changing reference systems for the production of knowledge. Since the basis for research and innovation is also being changed in techno-scientific development, the meaning of the concepts of disruption and disruptiveness in specific development and research practice must be sought in terms of which normative assumptions guide them. The change in socio-technically shaped knowledge spaces must be particularly taken into account here, while purely analytical investigations seem too abstract (Ropohl, 2009). Finally, only by referring back to practice can bring new approaches to coupling research in the humanities and social sciences on the one hand, and research in the natural sciences and engineering on the other. Hence, it emerges a concept of disruption that meets the demand for socially as well as ecologically responsible research and thus represents a disruption of "business as usual" in the academic context.

This is particularly important as the normative basis of the demand for disruption at the level of society as a whole is oriented towards ecologically as well as socially sustainable development paths. (Raworth, 2012; Leach, Raworth and Rockström, 2013; Steffen et al., 2015) Finally, the call for disruption in this context is linked to, and thus legitimised by, the demand to disrupt the business as usual. The implicit answer to the question of what is being "disrupted", forms

of path development at the economic and institutional level, is discussed further below.

3.2 Paradigm shift, path change, innovation and disruption

A present-hermeneutic approach (A. Grunwald, 2019) and an evolutionary model of path development (Gebauer, 2003) can be used to concretise heterogeneous disruption concepts. However, critical aspects also arise in particular from the present-hermeneutic investigation. For example, innovation cycles cannot be accelerated indefinitely without undermining social security mechanisms. New forms of work, without union protection or the like, make it clear that disruption cannot be a model for the future in itself(Grunwald, 2019, p. 137).

Fundamental aspects of disruption and disruptiveness also do not result from a "natural logic", but are revealed in the relationship of scientific theoretical concepts that offer interfaces to the concept of disruption. Such interfaces exist in the structure of scientific revolutions as well as paradigm shifts (Kuhn, 2007), from path developments and mechanisms of path change (David, 1985; Mahoney, 2000; Werle, 2007; Osburg and Schmidpeter, 2013), the transformation of knowledge systems (Augenstein et al., 2020; Fazey et al., 2020), and innovation research (Michelsen, 2010; Schmeisser et al., 2013; Schmidpeter, 2013; European Union Committee of the Regions, 2016). Thus, depending on the methodological background, different meanings emerge, which may, for example, exclude natural disasters or violent conflicts as well as upheavals (Schumpeter, 1912), have a stronger focus on scientific developments (Michelsen, 2010) or concern processes of institutional change. (Beyer, 2005)

Current approaches in the fields of technology assessment (Hussinga, 1985; Gebauer, 2013; Lindner et al., 2016; A. (KIT/ITAS) Grunwald, 2019) and Responsible Research and Innovation (Boenink and Kudina, 2020) lend themselves to research ethics.

Since the aforementioned points of contact for interpreting disruption lead to conflicting perspectives, the basic pillars of responsible research and innovation practice must also come into play in the reflection and evaluation of research projects related to disruptive research (reflexivity, reactivity, deliberation and anticipation).

In this sense, inter- and transdisciplinarity can not only be a dedicated research object (Jantsch, 1970; Mittelstraß, 2003; Frodeman, Thompson Klein and Mitcham, 2010; Jungert et al., 2013) but must also be understood as a methodological component in the engagement with the disruption concept.

However, in order to develop new approaches to coupling humanities and social science research with natural science and engineering research from the demand for disruptive research, further content-related focal points must be developed and summarised in an iterative process. That is, the content-related framing of the idea of disruption in research projects at the European level, such as in the context of Horizon Europe, as well as at the national level, for example in the context of the German Excellence Initiative, in relation to digitalisation (A. Grunwald, 2019) or also in relation to the responsible development of artificial intelligence (EU, 2019; Smuha, 2019), serves to ensure a conceptual framing of disruption that is oriented towards specific research practice.

4 Conclusions

Overall, it is clear that the notion of disruptive research faces a number of open questions. When talking about disruption, it is usually not clear how exactly the notion of disruption can be incorporated, explicated, or concretised in research practice.

In addition to the aforementioned scientific theoretical approaches to analysis, the discussion about disruption must therefore be oriented towards concrete projects. For example, the critical examination of existing research projects and dynamics lends itself to this. In order to define the abstract term and instrumentalise it as a legitimisation for forward-looking research projects, these questions would have to be clarified. In order to speak of disruptive research in the context of engineering and the natural sciences, it is not enough to extrapolate existing trends and thus arrive at predictions for the future, but the dynamics in the production of knowledge as well as the design of knowledge spaces must be understood in their own right as the object of investigation.

If disruption is assumed as some sort of hype and blindly adopted as a solution scheme in all technical as well as social problem areas, this ultimately conflicts with the notion of responsible research and development that solves pressing problems at the level of society as a whole.

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Use of the Smart Glasses in the Learning Surgery Residents: The Empirical Case

Concetta Lucia Cristofaro*

Ecampus University
Via Isimbardi 10
22060 Novedrate

Marzia Ventura

Università Magna Graecia di Catanzaro
Viale Europa
88100 Catanzaro (CZ)

Anna Maria Melina

Università Magna Graecia di Catanzaro
Viale Europa
88100 Catanzaro (CZ)

Rocco Reina

Università Magna Graecia di Catanzaro
Viale Europa
88100 Catanzaro (CZ)

* *Corresponding author*

Abstract

The outbreak of the COVID-19 pandemic has led to a sudden reorganization of surgical activities to deal with the global emergency. Non-urgent surgeries have been postponed providing resources for COVID-19 patients and non-deferrable cases. This collapse in activity has profoundly compromised the training programs of medical residents (whose activity is usually focused on inpatients, outpatient clinics, minor surgeries) (Hodges et al., 2020). An alternative to the traditional training method, where skills are acquired primarily in the classroom and operating theatre, is training with digital technologies that enable skills training remote. According to Vale et.al. (2021) in this transition process, teachers and students had to reflect, adapt, change, innovate and use digital tools. On these premises, the research focused on the implementation of Smart Glasses to support the training and learning of medical residents at the Hemodynamic Cardiology - Electrophysiology Unit of a University Hospital in Southern Italy. The methodological process was developed through a

qualitative approach based on a case study, according to the methods and indications suggested by Yin (2009), which involved the collection of data through semi-structured interviews and analysis of documents. The data reveal, the transition from face-to-face teaching to remote teaching, or online teaching and learning, became the possible alternative for Education institutions to ensure the continuity of courses and medical residents learning. In this case study, the technology used are the smart glasses web-connected glasses that can present data onto the lenses and record images or videos through a front-facing camera. The medical residents displayed positive attitudes towards using the new device. The study results show that technology tools can effectively improve learning efficiency and reduce learning cost and have shown that smart glasses training improved the technical abilities and reduced complication rates.

Keywords – Knowledge Sharing, Digital transformation, Smart Glasses, ICT tools, Case Study.

1 Introduction

The creation, acquisition, sharing and transfer of knowledge are essential elements of the learning cycle. Knowledge management and sharing processes are even more important for medical residents whose learning activities will help them to develop skills and services useful for others' health care and their own professional growth. On this premise, this paper seeks to explore the link between the process of knowledge sharing and medical residents with particular emphasis on the sharing of the different forms of available knowledge. Firstly, this paper will examine the literature related to knowledge sharing and its relevance for learning, including new technologies in healthcare. Therefore, a specific part of the work will focus on the case study under examination, analyzing knowledge sharing methods and tools used in interventional Medical Unit "Cardiology Hemodynamics – Electrophysiology "of the University Hospital in southern Italy. This article reports the use of "smart glasses" (by Rods&Cones Firm), for surgeon video streaming. The use of new technologies — including augmented reality — appears to be aimed at medical residents who share knowledge and acquire skills that are otherwise difficult to attain. Specifically, observation of surgical procedures performed by experts is extremely important for acquisition and improvement of surgical skills in the medical residents and allow trainees to experiment and face different challenges and other similar organizational processes useful for medical training.

2. Theoretical Framework

2.1. Knowledge Sharing and Learning in Healthcare

Knowledge is the most important strategic resource in organizations and its management is considered fundamental for organizational success (Nahapiet et al, 1998; Spender et al, 1996). Knowledge sharing is defined as the voluntary dissemination of acquired skills and experiences to the rest of the organization (Davenport, 1997; Ipe, 2003). The exchange of knowledge among individuals and among organizational units generates competitive skills that can lead to the success of organization (Ipe, 2003; Kogut & Zander, 1996; Nonaka & Takeuchi, 1995).

Nonaka and Takeuchi's well-known work on creating organizational knowledge emphasizes the explicit and tacit Knowledge interaction held by individuals, organizations and society. The model is shown in the Figure 1.

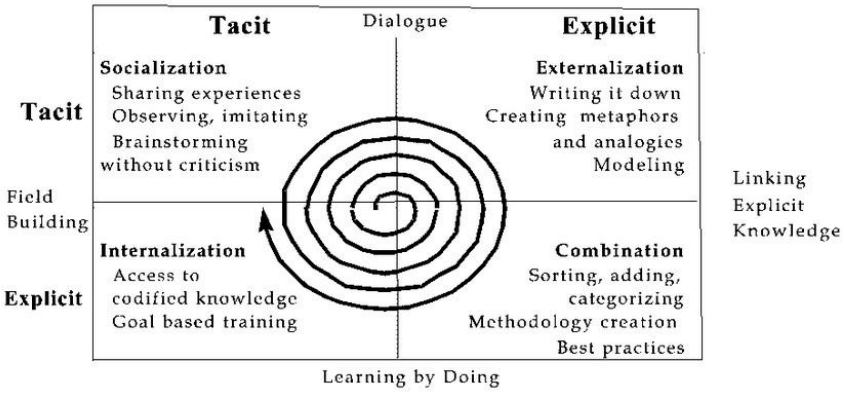

Figure 1. Knowledge creation Model
Source: Nonaka, I., & Takeuchi, H., 1995

According to Nonaka and Takeuchi (1995) the process of creating organizational knowledge is a circular dynamic process that never ends. The organization is stimulated by the environment.

Knowledge sharing has been linked to learning (Hurley & Hult, 1998; Weerawarden & O'Cass, 2004). Talking about organizational learning and organizational knowledge is therefore an implicit acceptance that knowledge is not just an individualized phenomenon, even if individuals are the basic "learning units". Hospitals and other health care facilities are knowledge-intensive

organizations where sharing both tacit (technical, expertise and experiential) and explicit (documented) is essential for the provision of quality health care (Saeed, 2009). The learning and sharing of knowledge among health professionals but especially among medical residents, are two essential aspects to ensure best practices in health care delivery. As a result, most healthcare organizations have implemented strategies that create opportunities for knowledge creation and sharing among their employees / medical residents to address the new challenges that organization faces in order to be successful for them (Steininger et al., 2010). For Ho et al. (2004) accident knowledge refers to learning from medical errors (Sim et al., 2001) and experience knowledge refers to experienced healthcare professionals who educate less experienced professionals on the best practice procedures (Stead & Lin, 2009).

Ruggles (1997) describes the different means of sharing knowledge identified in literature (Table 1).

Table 1: Knowledge sharing tools.

Type	***Tools***	***Authors***	***Definition***
Techniques	Communication Channels	Olsson et al 2008	Channels for communicating among staff members and between staff and patients including face-to-face, written communication,
	Social means	Zigan et al 2010	Every useful environment for sharing Knowledge
	Communities of practice	Wenger 2002	One group of individuals who share a concern about a topic and who deepen their knowledge in that area by interacting on an ongoing basis
	Training	Zigan et al 2010	Learning opportunities provided to share and receive required Knowledge
ICT	Social Technologies	Kahn et al 2010	Cover broad types of tools, all using technology to build collaboration and sharing Knowledge, they are mainly internet-based tools
	Clinical Decision Support Systems	Ozdemir et al 2011	An application that analyses data to help clinicians make clinical decision
	Electronic Health Record	Fichman et al 2011	Computerized health records to improve Knowledge sharing
	Mobile Phones	Gerber et al 2010	One useful tool for sharing medical Knowledge by using text messaging service or voice mail service
	Personal digital assistants	Kahn et al 2010	Shirt pocket sized tools that enable healthcare providers to gain access and share Knowledge
	Telemedicine	Singh et al 2010	Delivery of healthcare services using ICT for sharing of vital Knowledge for diagnosis, treatment and prevention of disease.

Source: adoption by Tabrizi and Morgan, 2014.

These different types of knowledge sharing means show the potential to greatly facilitate access to knowledge, improve communication, eliminate double documentation and, consequently, increase the quality of long-term health services (Ruikar et al., 2007; Gerber et al., 2010).

In the education context, the knowledge sharing among teachers is essential to encourage the proliferation of new knowledge thus adding value to the existing knowledge. Chang and Chuang (2011) believe that knowledge emerges from integrating information, experience, and theory. When people form groups and interact with each other, they tend to share knowledge and experiences, thus augmenting learning. Universities and students need to acquire sufficient flexibility in order to remain current and relevant in a rapidly changing educational environment (Milic et.al. 2016; Allen & Seaman, 2010), in this way ICT resources have become available, both for support of on-site education and for on-line learning.

However, access to these modern learning opportunities is dependent upon student skill in using these high-tech assistive technologies (Dunlap & Lowenthal, 2013; Toro-Troconis & Murphy,2014). Hodges et al. (2020) and Strangio et. al (2021) write that training programs of medical residents (whose activity is usually focused on inpatients, outpatient clinics, minor surgeries) been somewhat stopped or greatly jeopardized by the COVID-19 pandemic. An alternative to the traditional training method is training with ICT that enable skills training remote. This provided a broad reflection on new teaching methodologies, the creation of digital educational environments to develop the future of medicine (Guangul et al., 2020; Don et.al. 2021). The reflection on how to teach and learn, in a process based on digital tools, has led to a change in the educational paradigm (Marshall et.al. 2020), starting with educational technologies, and involving teachers and students in the same reflection and commitment (Flores & Swennen, 2020). According to Vale et.al. (2021) in this transition process, teachers and students had to reflect, adapt, change, innovate and use digital tools. To achieve this, educational institutions had to become a space for change, in order to respond to disruptive changes in the way of teaching, interacting with students and sharing on knowledge. Globally, advances in the strategies used in remote teaching are recognized, as well as in the sharing of materials via digital tools (Huber & Helm 2020; Judd et al., 2022; Flores et al., 2021; Horn & Staker, 2017). Laufer et al. (2021) characterize the functioning features of distance education. Kem (2022) explore key platforms for distance and smart learning. Parsons et al. (2022)

investigate the features of distance learning implementation according to respondent's experiences in New Zealand. Ayoub et al. (2020) analyze Coursera-based instructional design. Alfadda and Mahdi (2021) characterized the functionality of the Zoom platform. In addition, Wedari et al. (2022) also analyze the Zoom application in the context of its security, learning, and other features.

3 Research Methodology

This paper reports the results of a pilot study aimed at developing, implementing and evaluating the applicative use of "Smart Glasses" in Cardiology Emodinamica - Elettrofisiologia Unit of a University Hospital in southern Italy for medical residents. The methodological process was divided into two steps. It was developed a qualitative approach based on a case study, according to the methods and instructions suggested by Yin (2009), which involved collecting data through semi-structured interviews and document analysis. The documents considered were open access documents concerning the introduction of the Device "Smart Glasses" system to Cardiology Emodinamica - Elettrofisiologia Unit. Then a semi-structured interview was developed regarding the introduction and implementation of "Smart Glasses" system (Bamberger, 2000) and its role within the Medical Unit. Consistent with the purpose of our article, we conducted our interview with a privileged observer of this phenomenon: the member's staff. The interview, which lasted about 50 minutes and was reviewed and discussed to refine and improve the coding process. The interview focused, in primis on understanding the phenomenon, assessing whether the Covid-19 has changed educational contexts and subsequently, on the implementation process and the opportunities of Smart Glasses in the medical Unit.

3.1. The Case Study Analysis

Education is undergoing profound changes due to permanent technological innovations. This paper reports the results of a pilot study aimed at developing, implementing, and evaluating the medical Unit of a University Hospital in southern Italy for medical students.

Cardiac Unit of a University Hospital

Emodinamica Operating Unit

Member Staff	***number***
Medical Head	6
Medical Residents	32
Nurses	7
Practical nurses	5
Radiographers	3

Electrophysiologist Operating room of a University Hospital

Member staff	***number***
Surgeon	0
Electrophysiologist	2
Medical Residents	1
Nurses	1
Practical nurses	1

The Unit analyzed is home to an Italian pilot project conducted in collaboration with the Taranto and other European offices. To date, the surgeries that have seen the use of "Smart Glasses" are No. 6. Specifically, these are pacemaker implants and defibrillators.

4 The Results

Consistent with the purpose of our paper, we conducted our first interview with a privileged observer of this phenomenon—the medical and technical staff. The interview focused on understanding the phenomenon, evaluating the applicative use of Smart Glasses in the Unit.

HQ1: The Covid-19 has changed the education settings? And
HQ2: Are ICT tools a valuable support tool for the training of medical residents?

4.1 Focus: Summary of the interview

Head mounted smart glasses can be implemented for very basic purposes such as education, simulation, live streaming of visualized image, to more interactive functions such as video recording and digital photo documentation, for telemedicine and many others. Observing surgeries is essential for young surgeons-in training, but sometimes it is difficult for them to be able to get the

volume of exposure to surgeries that they need. If a surgeon records a procedure, the medical students could watch the procedure from the surgeon's point of view, either in real-time or post-operatively, to allow more flexibility.

The data reveal, the transition from face-to-face teaching to remote teaching, or online teaching and learning, became the possible alternative for Education institutions to ensure the continuity of courses and medical residents learning. The existence of available resources, such as the communication and collaboration platforms (Zoom and Google Teams and the Moodle) the videoconferencing, computerized communicator for the knowledge sharing (smart glass), and file storage paved the way for rapid adoption of emergency remote teaching.

The Smart glasses enabled the best training for the medical residents, because the tool allowed him to convey exactly what the training surgeon sees "looking over the surgeon's shoulder" or "standing next to him", also, can zoom in on the smallest details and make annotations (*taken from an interview with the medical and technical staff*). This innovative tool allows medical to teach remotely through the presentation and discussion of cases.

In clinical training, reviewing recorded video from the trainees' point of view enhances their self-reflection and increases trainer feedback. The students (medical residents) displayed positive attitudes towards using the new device and acquired the proper skills needed to function effectively in an information-rich environment. (*Taken from an interview with the medical staff)*. I am delighted that by using smart Glasses we are transporting our future surgeons directly into the operating theatre. Using this technology will support us to deliver high-quality training and safe care now and, in the future (*Taken from an interview with the medical staff*).

Finally, most of the actors involved claimed recognized that digital platforms made communication more flexible in time and space and, to that extent, facilitated interaction between all actors (*taken from an interview with the medical and technical staff*). The teachers considered that digital platforms were an asset to the teaching and that they should be integrated into the teaching environment, thus giving rise to a mixed learning environment (*taken from an interview with the medical staff*).

5 Conclusion

The Covid-19 pandemic it was a strong driver of the digitalization of teaching and learning and boosted the development of digital skills of teachers and medical residents. The study results show that technology tools can effectively improve learning efficiency and reduce learning cost and have shown that smart glasses training improved the technical abilities and reduced complication rates. In this case the teacher shared his knowledge with the medical residents enabling them to experience and deal with different challenges and other similar organizational processes useful for medical education. In the context of the Covid-19 pandemic crisis, training on remote took on a major role in most countries. However, due to its emergency nature, its implementation, in most cases, was not accompanied by all the necessary resources and support, which contributed to compromising essential. Despite the difficulties identified and having been experienced in a very different way by the different protagonists, we believe that this unprecedented experience not only achieved its main objective, but also configured an opportunity for the renewal of teaching and learning processes. In a short space of time, it induced a part of the teachers to change their methodological practices, pressured by the challenges posed by educational technologies and by the mediation of the teaching and learning processes by digital tools. In conclusion, during COVID-19 pandemic healthcare teams have been forced to work in an even safer and more efficient way, reducing footfall in the operating room to a minimum. In this scenario, the teacher is wearing Smart Glasses, this innovative tool allows doctors to teach at a distance through the presentation and discussion of cases. The medical residents have displayed positive attitudes towards using the new device and have gained adequate skills necessary to function effectively in an information rich environment.

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Paradoxical Tensions in Producing Knowledge for Environmental Planning and Decision Making

Jonna Käpylä

Faculty of Management and Business
Tampere University
Korkeakoulunkatu 8, FI 33014 Tampere, Finland

Abstract

Environmental impact assessment (EIA) is a procedure for producing knowledge for environmental planning and decision making. The aim of this study is to find out the information and knowledge management challenges of EIA and consider the connection between the identified challenges and paradoxical tensions in the knowledge production process. The aim is to answer the research question: What kind of information and knowledge management challenges and paradoxical tensions appear in the production of knowledge for environmental planning and decision making? The study was conducted as an interview study of EIA consultants and EIA authorities in Finland (n=24) with the aim of finding out how the practitioners of EIA understand the knowledge management practices of EIA. Results demonstrate the existence of different paradoxical tensions in the EIA procedure. Findings also reveal different identities of EIA authorities and EIA consultants and resulting differences between practitioners' way of thinking. For the EIA practice, this study concludes that even though EIA is a legal procedure, many paradoxical tensions affect how it is implemented in practice and what kind of impacts it has. An argument is presented that paradoxical tensions lie behind many of the challenges of information and knowledge management. Future research could delve deeper into the question of how EIA practitioners respond to the paradoxical tensions, and how these responses affect the effectiveness of EIA and sustainability outcomes.

Keywords – Knowledge Management, Information Management Cycle, Tension, Paradox Theory, Environmental Impact Assessment.

Paper type – Academic Research Paper

1 Introduction

The planning of large projects requires information about the sustainability and environmental impacts of the projects. The environmental impact assessment (EIA) is a procedure for producing this kind of information and knowledge for decision making (Cashmore et al. 2004; Morgan 2012). Many researchers have criticized EIA practice for not performing well enough (Cashmore et al. 2004; Pölönen et al. 2011). Solutions to this has been sought above all from legislation and regulations, even though EIA practitioners have a significant role to play in ensuring the quality of EIA. The focus has been on judicial and procedural development instead of EIA practitioners and their performance. Research is lacking about EIA from the perspective of management science and individual EIA practitioners (Chi et al. 2016). This is surprising, because along with the legislation, the discretion of EIA practitioners affects how the procedure is conducted (e.g., what information is produced and how it is used). In addition, EIA is recognized to be vulnerable to manipulation and corruption (Williams & Dupuy 2017; Enríquez-de-Salamanca 2018). Therefore, the discretion of EIA practitioners is crucial for the quality of EIA practice. In response, this study aims to extend the practitioner focus in the EIA research, which has been the motivation also in some previous studies (Kågström & Richardson 2015; Kågström 2016a; 2016b).

The aim of the study is to find out the information and knowledge management challenges of EIA and consider the connection between the identified challenges and paradoxical tensions in the knowledge production process. This study aims to answer the research question: *What kind of information and knowledge management challenges and paradoxical tensions appear in the production of knowledge for environmental planning and decision making?*

The research aims to contribute in two ways. First, by combining the theoretical perspectives of information and knowledge management and paradox theory, the analysis shows how the paradox theory may explain the reasons for the challenges of information and knowledge management. Second, the perspectives of knowledge management and paradoxical tensions provide a novel outlook on the EIA research, and the analysis of paradoxical tensions provides possible explanations for the differences in EIA practice. Only few studies have examined EIA from the perspective of knowledge management (Sánchez & Morrison-Saunders 2011; Sánchez & André 2013; Mitchell & Leach 2019). Furthermore, the

paradox perspective has not been previously applied to the context of environmental impact assessment, even though the management research on tensions and paradoxes is rapidly expanding (Putnam et al. 2016; Schad et al. 2016). The research field of organisational paradoxes (Putnam et al. 2016; Schad et al. 2016) offers insights into the management of tensions, where the concept of paradox or paradoxical tension has been used to describe and explain certain kinds of tensions. Research on paradoxes has developed towards a distinct perspective or a theory (Smith & Lewis 2011; Lewis & Smith 2014; Hahn et al. 2018). On this account, this study applies the knowledge management and paradox perspectives to the context of EIA, with the aim of increasing understanding about the EIA practice, especially from the perspective of the individual practitioners.

The paper proceeds as follows. Section 2 describes the theoretical background of the study. First, the context of the study, environmental impact assessment, and the previous research on the practices of environmental impact assessment is described. Then, the theoretical perspectives that are used in the analysis are presented: the information and knowledge management process model and the paradox theory. Section 3 describes how the research was conducted. Sections 4 and 5 present the results. Information and knowledge management challenges of EIA are discussed in Section 4. Section 5 delves into the paradoxical tensions that appear in the production of knowledge and identifies multiple identities of EIA practitioners. Finally, Section 6 presents discussion and conclusions. An argument is presented that paradoxical tensions lie behind many of the challenges of information and knowledge management.

2 Theoretical background

2.1 Environmental impact assessment (EIA)

Environmental impact assessment, abbreviated as EIA, is a key tool in producing knowledge for environmental planning and decision making. It is a preventive and participatory procedure that aims to ensure that the environmental implications of projects that may cause significant adverse environmental effects are taken into account before their approval or authorisation. It is carried out in the planning phase of a development of e.g., an industrial plant, mining establishment or road infrastructure and it aims to

produce knowledge to be used in the decision making (i.e., in the consent decision and project design decisions). Since its introduction to the National Environmental Policy Act of 1969 (NEPA) in the USA, the institutionalisation of EIA has progressed steadily, and is now used in most countries in the world (Morgan 2012). Even though "EIA is now universally recognized as a key instrument for environmental management, firmly embedded in domestic and international environmental laws" (Morgan 2012, 6), many researchers have criticised EIA practise for not performing well enough (Cashmore et al. 2004; Pölönen et al. 2011).

In Finland, EIA is a two-stage procedure consisting of the making of assessment program and assessment report. The developer of the project (i.e., company or public actor) is responsible for the assessment process. Typically, the developer hires a consultant to conduct the necessary environmental investigations. The procedure is supervised and controlled by the ELY Centres, who act as EIA authorities. After both the program and the report, a hearing is arranged, statements and opinions are gathered and a statement by the coordinating authority (ELY Centre) is given.

The EIA procedure aims both for environmental effectiveness and participatory/democratic effectiveness. Environmental effectiveness can be interpreted as the extent to which environmental issues are fully considered in decision making and the extent to which environmental awareness is increased (Arts et al. 2012; Jha-Takur & Fischer 2016). Cashmore et al. (2004) distinguish the contribution of EIA to the consent decision (i.e., formal license to operate, environmental permit) and to decisions about the project design. Participatory/democratic effectiveness can be approached from different dimensions, such as empowering marginalised individuals, harnessing local knowledge, generating legitimacy, and resolving conflict (Glucker et al. 2013). Generally, the prevention of significant harmful environmental consequences is seen as the key goal of EIA and the cornerstone of effectiveness evaluations (Bartlett & Kurian 1999; Pölönen et al. 2011; Arts et al. 2012; Zhang et al. 2013; Jha-Takur & Fischer 2016).

The theory and practise of EIA have gained lot of attention in the literature (Morgan 2012; Pope et al. 2013). The quality of the EIA practice (e.g., Bond et al. 2018) and the effectiveness of EIA (e.g., Pölönen et al. 2011; Arts et al. 2012; Loomis & Dziedzic 2018) have been the focus of many studies. The research has typically identified strengths and weaknesses in different phases of the EIA

procedure and approached EIA from the perspective of judicial and procedural development (i.e., how to develop regulations and legislation in order to improve the quality and effectiveness of EIA). The approaches of administrative and management science have been scarce, even though the functionality and effectiveness of EIA is not solely determined by legal regulation (Chi et al. 2016). For instance, in Finland, the EIA legislation leaves a lot of room for interpretations of how assessment practices should be implemented (Jalava 2014).

The roots of the EIA lie in the rationalist approach to decision making (Jay et al. 2007) but the value-laden nature of EIA is currently widely acknowledged. The procedure of EIA can be characterised as a context with pluralism (Bond et al. 2018). It includes multiple stakeholders (e.g., the developer, consultant, authority, and citizens) with conflicting interests and expectations about the purpose, quality, legitimacy, and effectiveness of EIA (Cape et al. 2018). At the same time when the interpretative and value-laden nature of EIA practise has come to the fore, the significant role of EIA practitioners in guiding EIA practice has been recognized. However, only a few studies (Kågström & Richardson 2015; Kågström 2016a; 2016b) have studied EIA from the perspective of how the EIA practitioners make sense of the procedure.

EIA thus includes many practitioners and stakeholders, of which EIA consultants typically have an important role as producers of knowledge, i.e., as assessors, whereas competent authorities have their role as supervisors and reviewers of knowledge. In addition, EIA allows different stakeholders (e.g., citizens and their communities) with differing interests to participate in the evaluation process, so EIA is a knowledge co-production process and a field of dispute used to promote political purposes. For instance, EIA can be harnessed by the developer for legitimation purposes, and the opponents of the project can use EIA to prevent the project from materializing (Jalava 2014). Practitioners and stakeholders have different interests, so there exist different views about what kind of knowledge is needed and how this knowledge should be produced, shared, and presented.

2.2 Information and knowledge management process model

Since knowledge is created in EIA, and EIA aims to solve the problems of knowledge and respond to the information needs of various actors, the perspective of knowledge management is a relevant approach to examining the conduct and effectiveness of EIA.

Overall, information and knowledge management refers to a systematic process that aims to create value from data, information, and knowledge (Jääskeläinen et al. 2022). Choo's (2002) information management cycle is widely referred and applied model in the field of information and knowledge management (e.g., Jääskeläinen et al. 2022). It distinguishes six separate but related phases in the information management process: information needs, information acquisition, information organization and storage, information products and services, information distribution, and information use.

In this study, this process model is simplified to the context of environmental impact assessment by combining the phases of information acquisition, organization and storage into a phase called information acquisition and analysis, and the phases of information products and services and information distribution into a phase called information presentation and sharing. This model that is presented in Figure 1 is used in this study as an analytical framework to identify information and knowledge management challenges and paradoxical tensions in the EIA process.

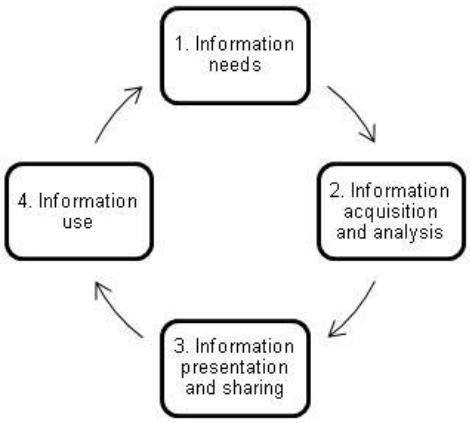

Figure 1. Information and knowledge management process model (based on Choo 2002).

At the core of the information and knowledge management process model is the idea of managing information and knowledge so that the knowledge is also used in practice and decision-making (Choo 2002). This requires exact definition of information needs. The model is based on the idea that information needs determine the desired (produced) information and knowledge. In practice, however, information is not necessarily produced from the perspective of

assumed need, but problems are caused by overproduction of irrelevant information or refraining from producing relevant information (Jalonen 2015).

2.3 Paradox theory and paradoxical tensions

Paradox theory is built on the concept of paradox. Paradox is typically illustrated by the symbol of yin and yang that describes two oppositional yet complementary elements. The concept of paradox refers to "contradictory yet interrelated elements that exist simultaneously and persist over time" (Smith & Lewis 2011, 386) or to a "persistent contradiction between interdependent elements" (Schad et al. 2016). Hence, three factors are central to the concept of paradox: contradiction, interrelatedness, and persistence (Smith & Lewis 2011). Overall, there exists a widespread consensus among researchers about what the concept of paradox generally means.

In the paradox literature, paradoxes are typically categorized into four types: paradoxes of learning, organising, belonging, and performing (Smith & Lewis 2011). Paradoxes of learning relate to the processes of sensemaking, innovation and change. Learning simultaneously requires the use of past understandings and the critique of them so to construct new understandings. At the core of the learning paradox is the tension between the old and the new, between the existing and novel practices, between radical and incremental innovations, whether to aim for exploitation or exploration, for stability or change. Paradoxes of organising appear as tensions in the processes, structures, and methods, which aim to simultaneously maintain and encourage control and flexibility, collaboration and competition, or direction and empowerment. Paradoxes of belonging describe the tensions between identities. Paradoxes of performing stem from the multitude of stakeholder demands that result in competing organizational objectives and goals. (Smith & Lewis 2011) Hence, paradoxes appear as tensions in knowledge, identity, processes, and goals, which create tensions in management and governance. In this paper, the terms paradox and paradoxical tension are used synonymously.

Responses to the paradoxical tensions can vary, which affects the consequences of these tensions in practice (Lewis 2000; Smith & Lewis 2011). Responses to such tensions may be different, and other responses may lead to long-term success whereas other may lead to vicious circles (Lewis 2000; Smith & Lewis 2011). Currently, researchers typically separate two opposing ways of

responding to paradoxes: defensive and active or strategic (Jarzabkowski & Van de Ven 2013; Iivonen 2018). Lewis and Smith (2014) describe the defensive responses as "cognitive, behavioral, or institutional resistances that seek to temporarily avoid or reduce the negative effects of tensions", and strategic responses as "management strategies that seek to engage competing forces". So, while defensive responses aim to eliminate the tension, active responses try to embrace it. Poole and Van de Ven (1989) distinguish four different modes of active responses: acceptance, spatial separation, temporal separation, and synthesis. While defensive responses provide temporary relief from tensions, vicious cycles are possible, whereas active responses provide opportunities for virtuous cycles (Lewis & Smith 2014).

In this study, the paradox theory is used as a methodological lens or a detective analytical tool to identify paradoxical tensions in the production of knowledge in EIA process (see different uses of paradox in Carmine & De Marchi 2022).

3 Research method

The study was conducted as an interview study of EIA consultants and EIA authorities in Finland between the fall of 2016 and spring of 2017 (n=24). The purpose of the interviews was to find out how the practitioners of EIA understand the knowledge management practices of EIA. So, the focus was on the mindsets of EIA practitioners and not on the concrete practices of the EIA procedure as such.

Both EIA consultants and EIA authorities have a key role in producing knowledge in EIA. EIA consultants do the assessments and produce knowledge, and, unlike most developers, they often have experience in several and different types of EIA projects. The interviewees represented a total of ten different consulting companies. EIA authorities, in turn, supervise the production of knowledge. The interviewed EIA authorities were located in ten different ELY Centres: Lapland, North Ostrobothnia, Central Finland, Southwest Finland, Uusimaa, North Savo, Southeast Finland, Kainuu, North Karelia and South Savo. The regional coverage of ELY Centres was seen important because of the regional variations in projects: some project types are more common in some parts of country.

Apart from five interviews that were carried out as phone interviews due to practical logistical reasons, the interviews were conducted face-to-face. Two of the interviews with EIA consultants were joint pair interviews, others were individual interviews. The duration of the interviews ranged from 56 minutes to 200 minutes, with an average of 1 hour and 31 minutes. All interviews were transcribed, resulting in a total of 488 pages of material. Based on the transcription, a summary was written of each interview. The summary and transcription were also sent to each interviewee for possible corrections and additions to ensure reliability.

The analysis of the interview data was conducted as a theory-driven analysis. Information and knowledge management process model (section 2.2.) and the different types of paradoxes (section 2.3.) worked as theoretical frameworks, which helped to identify and categorise information and knowledge management challenges and paradoxical tensions from the interview data.

The analysis was done in two phases. First, the focus was on the question how the EIA procedure implemented information and knowledge management, and what kind of challenges related to the different phases of information and knowledge management. Second, the focus was on the paradoxical tensions and the question of what kind of paradoxical tensions appear in the different phases of information and knowledge management.

4 Information and knowledge management challenges in the EIA

The analysis suggests that the key knowledge management challenge of the environmental impact assessment procedure is that the multiple information needs are not systematically identified and evaluated. Information and knowledge are primarily produced for the sake of the procedure without evaluating the different contexts on which the knowledge is to be (or could be) used. Figure 2 summarizes the challenges of information and knowledge management in the different phases of the process.

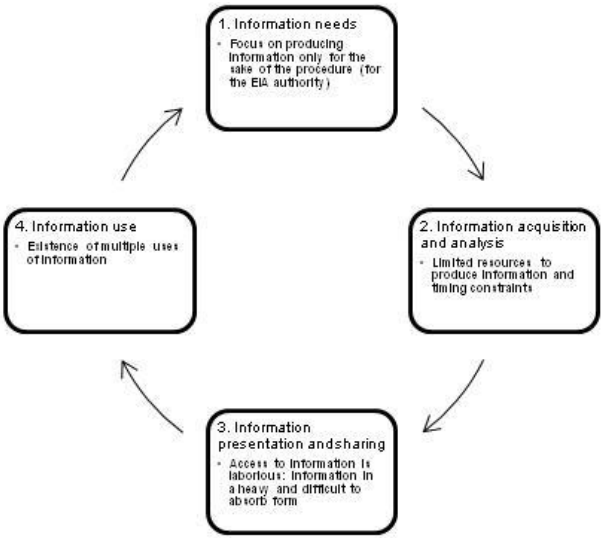

Figure 2. Information and knowledge management challenges in the EIA.

The developer decides on the timing of the EIA and determines how much resources will be used for the EIA, which sets limits for the knowledge production (phase 2). Information is presented in a heavy and not in an easy-to-adopt form, which furthermore hinders the use of information (phase 3). Finally, the existence of multiple uses of information makes the process challenging to manage (phase 4).

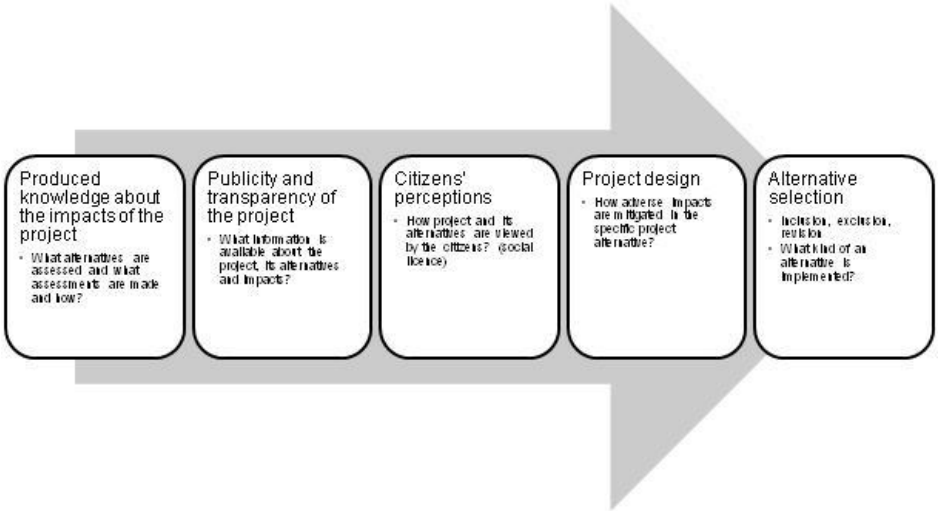

Figure 3. The use of EIA information.

Figure 3 illustrates these multiple uses of EIA, and how the produced information and knowledge affects or may have effect on the alternative selection, project design, citizens' perceptions, and on the publicity and transparency of the planned project.

5 Paradoxical tensions in the EIA

The analysis brought up especially paradoxes of performing, which relate to the competing objectives or goals. In the first phase of defining the information needs, the performing paradoxical tension relates to the extent of consideration of different information needs. There is a tension between producing knowledge for the purpose of the procedure (when the focus is on the sufficient level of assessments and on cost-effectiveness) and producing knowledge for the purpose of fulfilling different information needs. This links directly to the challenge of producing information for the sake of the procedure and for the EIA authority only.

In the phase of acquiring and analyzing information, the performing paradoxical tension relates to the timing of knowledge production, whether the objective is to influence planning of the project as much as possible (i.e., to the comparison and choice of alternatives), which is easier at the early stages of the project planning, or to get as accurate and comprehensive assessments as possible, when the planning is already advanced. In addition, there is the performing paradox that relates to the extent of new knowledge production. There is a tension between the appropriateness of assessments to the context and the will to keep the level of assessments high and raise it. So, there can be simultaneously a will to treat developers equally and be reasonable in demands, and the perseverance to demand complete assessments of high quality. Both paradoxical tensions link to the challenge of limited resources to produce information and timing constraints.

In the phase of information presentation and sharing, the key paradoxical tension is a performing paradox that relates to the simplicity and comprehensiveness of information presentation. When the assessment is presented in a simple form some details are missed. There is a tension between the scope and richness of assessment reports and the readability of assessment reports. This links directly to the challenge that information is presented in a

heavy and not in an easy-to-adopt form, which hinders the sharing of information to the public.

In the last phase of information use, no paradoxical tensions emerged in this study. Table 1 summarizes the paradoxical tensions in the EIA. It also illustrates how paradoxical tensions are linked to certain information and knowledge management challenges. The paradoxes of belonging that relate to the competing identities of EIA consults and authorities do not focus on a certain phase of the information and knowledge management process but are present throughout the whole process.

Table 1. Paradoxical tensions in the knowledge production of EIA.

The phases of information and knowledge management process and the related challenges	***Paradoxical tensions***
I Information needs *Challenge*: Focus on producing information only for the sake of the procedure (for the EIA authority)	**(1) Extent of consideration/inconsideration of different information needs**: Producing knowledge for the purpose of the procedure (cost-effectiveness, sufficiency) vs. Producing knowledge for the purpose of fulfilling different information needs *EIA consult*: Goals of the customer/developer vs. Goals of the EIA authority
II Information acquisition and analysis *Challenge*: Limited resources to produce information and timing constraints	**(2) Timing of knowledge production:** Possibility to influence planning vs. Accurate assessments *EIA authority:* Ensuring the choice and comparison of alternatives (early timing) vs. Ensuring comprehensive assessments (late timing) **(3) Extent of new knowledge production and exploration**: Appropriateness of assessments to the context and ability to limit assessments vs. Keeping the level of assessments high and raising it *EIA authority*: Aim for better quality assessments (aiming for higher standards than in the past) vs. Equal treatment of developers. *EIA authority*: Perseverance to demand complete/proper assessments vs. Reasonableness in demands
III Information presentation and sharing *Challenge*: Access to information is laborious: information in a heavy and difficult to absorb form.	**(4) Simplicity and comprehensiveness of information presentation**: The scope and richness of assessment reports vs. Readability of assessment reports
IV Information use *Challenge*: Existence of multiple uses of information (and the	N/A

need to consider different users' needs)	
Process as a whole	**(5) Competing, concurrent identities of EIA practitioners** *EIA consult*: Identity as an objective researcher/scientist vs. Identity as a customer server agent vs. Identity as a broker/interpreter *EIA authority*: Identity as a partner in joint deliberation and cooperation and guidance through collaboration and teamwork (subjectivity, participation) vs. Identity as a supervisor and guidance through statements (objectivity, independency

Paradoxes of belonging describe the tension between identities. From the data it was possible to identify competing identities of EIA consultants and authorities. These identities are described in Table 2. Interviewees represented the identities simultaneously with different emphases. For instance, an interviewee may emphasize the identity of an objective researcher but also represent the identities of customer server agent and broker in a certain degree – or alternatively with different emphases.

Furthermore, paradoxes of performing and organizing can be recognized from the background of the paradoxes of belonging. The different identities of EIA consultants reflect the paradox of performing, i.e., tension between goals. The objective researcher aims for comprehensive and accurate assessments and knowledge of good quality. Customer server agent aims for taking care of the developer's advantage putting emphasis on producing appropriate knowledge cost-effectively. Broker/interpreter aims for building consensus between different actors and their demands.

The different identities of EIA authorities reflect the paradox of organizing. The supervisor aims to ensure the assessments are made in compliance with the law, whereas the partner aims to participate in joint deliberation and collaboration to ensure that the planning of the project proceeds in a best possible way considering the environmental and social impacts. The supervisor relies on guidance through statements, whereas the partner relies on guidance through teamwork. It is a tension between control and flexibility as well as between supervision and collaboration.

Table 2. Multiple identities of EIA practitioners.

Identities of EIA practitioners		*Characteristics Purpose*	*Guiding principle*	*Ideal role*
EIA consultants	**Objective researcher**	To assess impacts objectively and find solutions to problems	Objectivity, Transparency, Independency	Scientist
	Customer server agent	To serve the developer	The care of the customer's advantage, Reasonableness	Servant
	Broker /Interpreter	To support planning of the project and disseminate knowledge between participants to support knowledge co-creation.	Equal treatment, Openness, Innovativeness	Pragmatic developer and diplomat
EIA authorities	**Supervisor**	To ensure that assessments are made in compliance with the law – Power in form of official statements.	Compliance with the law, Objectivity, Independency	Legal authority
	Partner	To support planning of the project in compliance with the law – Informal power through discussions	Expertise, Innovativeness	Collaborator

In summary, paradoxical tensions in the knowledge production relate to five different aspects. The first is about the recognition or inconsideration of information needs, i.e., whether information is produced for the sake of the procedure or whether the information needs are considered more extensively. This also reflects the tension between the costs and the quality of knowledge. The second aspect is about timing, i.e., when information and knowledge should be produced. Timing should at the same time be early regarding the project planning to ensure the choice and comparison of alternatives, and late to ensure comprehensive and accurate assessments cost-effectively and with minimal uncertainties. The third aspect is about the quality of the produced knowledge, i.e., should the depth and scope of knowledge depend on the context or be of high quality in every regard. The fourth aspect relates to the way information is presented and shared: how to nurture both simplicity (e.g., readable reports) and accuracy (e.g., comprehensive reports). The fifth aspect is about the different approaches to the knowledge production process demonstrated by the competing, simultaneous identities of the actors.

6 Conclusions

This research identified four information and knowledge management challenges in the EIA process, where knowledge is produced for environmental planning and decision making: 1) focus on producing information only for the sake of the procedure, i.e., for the EIA authority, 2) limited resources to produce information and timing constraints, 3) access to information is laborious, and 4) the existence of multiple uses of information. Furthermore, the results demonstrate the existence of five paradoxical tensions in the EIA procedure, where knowledge is produced for environmental planning and decision making: 1) consideration/inconsideration of information needs, 2) timing of knowledge production: the choice and comparison of alternatives (early timing) vs. comprehensive assessments (late timing), 3) extent of new knowledge production, 4) simplicity vs. comprehensiveness of information presentation, and 5) competing, concurrent identities of EIA practitioners.

This study concludes that paradoxical tensions lie behind many of the challenges of information and knowledge management, i.e., paradoxical tensions and information and knowledge management challenges are interlinked. This implies that paradox theory may explain the reasons for the challenges of information and knowledge management.

Findings reveal different identities of EIA authorities and EIA consultants and resulting differences between practitioners' way of thinking. This can be seen as a possible explanation for the recognized differences in EIA practice. For the EIA practice, this study concludes that even though EIA is a legal procedure, many paradoxical tensions affect how it is implemented in practice and what kind of impacts it has.

This study did not investigate whether differences exist in the concrete practices of writing EIA reports and statements, but it shows the existence of differences in the mindsets of EIA practitioners. The different responses to paradoxical tensions in knowledge production may offer one explanation for the differences in EIA practice. Future research could delve deeper into the question of how EIA practitioners respond to the paradoxical tensions, and how these responses affect the effectiveness of EIA and sustainability outcomes.

Future research could also find out what kind of paradoxical tensions can be identified from the structures and processes of knowledge production in EIA. This study sees paradoxical tensions as cognitively and socially constructed. In

contrast, the ontological nature of paradoxes could be seen differently – not as mental representations that are constructed in the cognition and rhetoric but as material construction that are system contradictions inherent in intra- and inter-organizational practices and structures (Lewis 2000). It is possible that not all paradoxical tensions and responses to these tensions will come out in the speech of EIA practitioners that was the focus in this study.

Acknowledgements

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Towards a Definition of Tourism Ecosystem

Rachele Vanessa Gatto*

School of engineering
University of Basilicata
Viale dell'Ateneo Lucano 10, 85100, Potenza (IT)

Simone Corrado

School of engineering
University of Basilicata
Viale dell'Ateneo Lucano 10, 85100, Potenza (IT)

Francesco Scorza

School of engineering
University of Basilicata
Viale dell'Ateneo Lucano 10, 85100, Potenza (IT)

* *Corresponding author*

Abstract

Public investment programs consider tourism as a key driver to support the process of territorial development in in-land rural areas. Tourism activities increase production, safeguard tangible and intangible cultural heritage and foster social cohesion due to the high level of collaboration among operators and multifunctionality in a tourism supply chain. A generalised feature of tourism development strategies and projects is to be proposed as an alternative means of solving problems facing rural economies. The goal of enhancing local cultural resources is to stimulate demand for goods and services from external sources, ultimately aimed at mitigating the negative effects of marginalization and demographic decline.

Studies on systems for evaluating the effectiveness of current tourism-related policies adopt a fragmented and sectorial approach that may be useful for identifying variations in structural socio-economic trend but, mainly, fail to produce a comprehensive picture of the impact of tourism development investments over time.

However, given that tourism is a complex, multifaceted phenomenon that involves the contributions of multiple disciplines in both research and policy-making, the absence of an integrated framework for monitoring is a structural weakness. Such a framework would enable a more comprehensive understanding of the impact of tourism in a specific location. The study sets forward a framework hypothesis which, through the systematic

reading of selected practices, introduces evaluation criteria for successful strategies proposing an operative definition of “tourism ecosystems” to be adopted in multidisciplinary research project promoting tourism sustainable development (TechForYou).
The paper, after highlighting the lack of a common metric and the problems relating to tourism strategies, proposes an operational definition of the tourism ecosystem considering the cross-sectoral nature of tourism sector.

Keywords – Tourism ecosystem, Sustainable Development, Rural Areas.

Paper type – Academic Research Paper

1 Introduction

A number of public investment programs supporting the local sustainable development of rural areas consider tourism as a catalyst for the territorial capital's regeneration process (Croes et al., 2021). The development of Italy's tourism sector was significantly aided by EU funding from 2007 to 2013. Italy was required to contribute to the projects since the resources from the European Regional Development Fund (ERDF) and the European Social Fund (ESF) were combined with co-financing from the Italian government. Further funding for tourism development was also provided by the National Fund for Development and Cohesion (FSC) and the Action Plan for Cohesion (PAC).

Tourism has the potential to provide a valuable alternative to the crisis affecting rural economies through new sources of income as a response to a demand for goods and services related to tourism flow (Sharpley, 2002). According to the goals, resources, and governance outlined in the National Strategy for Internal Areas (SNAI), tourism is given a crucial role in the occurrence of the following conditions: "increase in income, increase in social cohesion, reduction of social costs, restoration of ecosystem balances, maintenance of historical and artistic capital" (Agenzia per la Coesione Territoriale, 2014).

If we focus on small Italian towns and settlements in in-land rural area characterized by inadequate accessibility to the main development poles and deteriorating infrastructure for personal services, classified by SNAI, many development experiments with recurring tourism models can be identified. The general purpose of enhancing (even boosting) the region's prominent tangible and immaterial tourism assets (natural, cultural, social) represent a replicable approach in design tourism development strategy (Andreoli & Silvestri, 2017).

In such instances, it becomes apparent that a restructuring of tourist offerings, with a focus on providing experiential and naturalistic activities, based on the identification of identity values (Carneiro et al., 2015) as well as a highly diversified range of tourism facilities, is necessary in the midst of a transition in tourism marked by the decline of mass tourism and the emergence of new leisure activities (Salvatore et al., 2018). The principles of "integration," "multifunctionality," and "place-based approach," supported by monitoring capacity to identify socio-economic trends and territorial effects, have emerged as criteria for the development of more effective tourism strategies.

This study aims to discuss a preliminary analysis of the current situation regarding the intervention strategies based on tourism development by providing an overview on the problems related to a weak programming capacity. Next, we look at the current approach used to monitor the success of intervention lines. Considering tourism as a cross-disciplinary integrated subject and the fragmentary nature of the current approach in the planning cycle a definition of the "tourist ecosystem" is proposed as a basic concept informing the wider research structure of the TechForYou[1] project. In the conclusions future related research scenarios are proposed defining conceptual and technological implications.

2 Tourism in planning

Today, three different approaches can be identified to explain how tourism affects local development (Porter, 1998) (Andreoli & Silvestri, 2017) The following are domains of local context resource exploitation: a) temporary devices that generate tourism supply and demand (i.e., main attractor structures); b) improvements in accommodation infrastructure and the provision of tourism services; c) innovation and increased creativity in the network system between local and non-local actors.

While it is demonstrated that tourism flows open up growth opportunities in the destination areas/sites, the impact over the long run in some circumstances is debatable (Balaguer & Cantavella-Jordá, 2002). A specific argument of impact analysis is the durability of the positive socio-economic effects over time and the risk of over-tourism pressure on the cultural/natural/social values in the medium long term.

[1] *https://www.tech4youscarl.it/*

The results of the current tourism policy, which is based on the development and application of generalized approaches (also referred to as "main attractor"), demonstrate a significant contribution to increase the tourist presences, but the data analysis highlights the ineffectiveness on the trend of socio-demographic trends (Scorza & Gatto, 2023). It is difficult to quantitative assess and model the relation between territorial regeneration combined with tourism infrastructure investments in marginal areas and economic growth (Gatto et al., 2022a, 2022b).

The distinctive characteristics of the context, according to recent study, have a significant impact on the likelihood of an investment's success (Brau et al., 2011), stressing the importance of human capital in the process of generating goods and services for the tourism industry (Pigliaru & Lanza, 2005).

Analysing objectives and monitoring systems of internal areas, however, a critical perspective emerges for territorial development planning in all phases of the planning cycle (Las Casas & Scorza, 2016): from the ex-ante evaluation which includes the classification of the in-land rural areas benefiting from public resources, passing from the evaluation and definition of the problems, from the construction of the logical link between directly correlated actions and expected results and the convenience of the investment up to the final phases of verification and post-realization verification. In fact, there are realities and traits founded in social practices and traditions that continuously modify the landscape inside the homogeneous areas identified by SNAI, making the identity values of the places obvious (Scorza & Gatto, 2023). The informal mechanisms that contribute to sustaining subsistence economies entrenched in the cultural system of the permanent population are represented by the niches of value. They are primarily experiential tourism-related activities that take place as a result of watching actors' interactions with service-oriented environments change.

Furthermore, the tourism industry's emphasis on providing a variety of services, rather than exchanging physical products, has led to the development of several theories that reinterpret organizational models based on the co-creation of value within systems (Polese et al., 2018). To facilitate the tourism transition in rural areas and achieve a fair balance between social, environmental, and economic factors, it is crucial to comprehend the complex network of connections and interdependencies between the various components of a "tourist ecosystem".

3 Tourism ecosystem frameworks

3.1 Evaluation of successful tourism funding

Tourism development objectives in Europe include fostering the creation of high-quality jobs, fostering the sector's diversity and competitiveness, and promoting sustainable growth. Diverse sub-sectors of tourism exist, including those centred on nature, culture, health, and adventure. To encourage sustainable tourism development, a comprehensive plan that incorporates market research, product development, marketing, and stakeholder engagement is required.

The monitoring mechanism used to evaluate the efficacy of sustainable tourism strategies and practices is still insufficient to learn from data evidences in order to define more effective tourism models to be considered as a DSS in planning sustainable development in inland and weakest areas. Despite the efforts of numerous organizations and governments to promote sustainable tourism, today a shared framework guide for sustainable tourism strategies design is still missing with negative consequences in information sharing, comparability of approaches, lessons learned.

The United Nations World Tourism Organization (UNWTO) plays a significant role in promoting sustainable tourism worldwide. Through its programs and initiatives, UNWTO seeks to foster tourism that maximizes economic, social, and environmental benefits while minimizing negative impacts. Some key principles of sustainable tourism promoted by UNWTO include responsible consumption of resources, preservation of cultural and natural heritage, and respect for local communities and their interests.

The current system heavily relies on quantitative metrics that fail to fully capture the intricate and diverse components of sustainable tourism, including visitor numbers and economic impacts (Corrado & Scorza, 2022). Furthermore, the system often neglects qualitative factors, such as destination competitiveness, stakeholder involvement, and environmental and social implications. As a consequence, it is imperative to develop more comprehensive monitoring frameworks that consider local contexts, encompass the multifaceted aspects of sustainable tourism, and facilitate effective decision-making and policy implementation.

It is a challenging task to evaluate the effectiveness of tourist public funding, and many approaches have been put out to measure its influence. Utilizing

economic metrics like job growth, income generation, and tax receipts is one strategy (Plzakova, 2022). Another strategy is to consider social and environmental indicators including participation in the community, preserving the environment and cultural preservation (Andereck & Nyaupane, 2011; Jepson & Sharpley, 2015) A third strategy is to gauge how satisfied visitors and locals are with the tourism offering and how they feel it has affected their quality of life (Buhalis, 2000).

Planning and development for the tourism industry frequently exclusively refers to economic impact assessments. Input-output analysis is a widely used technique that estimates the economic advantages of tourism in terms of jobs, income, and taxes. Cost-benefit analysis is a different strategy that assesses the financial costs and gains of tourism development initiatives (Plzakova, 2022).

Assessments of the social and environmental impacts of tourism, particularly ecotourism and sustainable tourism, have grown in importance. These evaluations examine the social and environmental effects of tourism initiatives and look for ways to lessen negative effects while enhancing favourable ones (Sharpley, 2002).

Surveys of customer satisfaction and perception are yet another crucial tool for assessing the effectiveness of tourism investment. These polls can provide information about how locals and visitors perceive tourism, as well as point up areas (physical areas in the destination sites and functional areas in the local tourism supply chain) that need to be improved (Buhalis, 2000).

In general, the methods employed to assess the efficacy of tourism financing are diverse and extensive, reflecting the intricacy of the industry and the multitude of stakeholders involved in its growth (Scorza et al., 2022; Soligno et al., 2015).

3.1 Theoretical framework

According to the concept of "tourism ecosystem" intended as a model to adopt in designing, monitoring and implementing tourism development in weakest areas, a comprehensive survey technique that demonstrates the effect that tourism services have on the area must be defined. Research efforts to define creative habitats for territorial tourist ecosystems are actively contaminated by the definition of an integrated approach focused on the involvement of local communities. Tourism, as an area transversal to different disciplines, is tackled by

fragments and steps in the logic of measurement (Merinero-Rodríguez & Pulido-Fernández, 2016).

In order to define a functional framework for the evaluation and interrogation of the territorial system of the role of tourism in the global vision, the study attempts to conceptually frame the concept of "tourism ecosystem" starting from the literature. When considering tourism as a relational phenomenon, a systematic approach is necessary, which asks for tools that can be used to analyse the phenomenon's various components and the connections among them (Picaud-bello et al., 2022). However, the structure of the relationships between the various sectors and the definition of the same serve as a significant starting point for identifying successful strategies and for identifying the locations that are best suited for particular types of tourism in the following stage.

An area's production and consumption of tourism-related goods and services are governed by a network of interrelated and interdependent players, resources, and processes (Hillebrand, 2022). The architectural and natural environments, cultural assets, human resources, transportation networks, and organizations involved in the development and management of tourism are all included in this. The idea underlines the necessity for a comprehensive strategy for tourism development that considers the interactions between various ecosystem components and the sustainability of the system as a whole.

Researchers in the field of tourism studies, have proposed the concept of a tourism ecosystem, arguing that tourist destinations can be viewed as complex adaptive systems that change over time in response to environmental changes as well as the actions of tourists and other stakeholders (Picaud-bello et al., 2022).

The ecosystem method has been used to study the effects of tourism on regional communities and the environment as well as to inform policy and planning choices meant to encourage the development of a sustainable tourism industry (Gretzel et al., 2015). Overall, the idea of a tourism ecosystem underlines the complexity and interconnection of the sector and the demand for a thorough and sustainable approach to tourism planning and management. It offers a framework for comprehending the dynamic connections between various tourism system components and for formulating plans to encourage the long-term viability of tourist destinations.

According with those considerations the proposed definition of "tourism ecosystem" is: *A tourist ecosystem is defined as a network of interrelated and*

interdependent nodes that characterize a tourist destination area providing benefits in a territorial development scenario.

The analysis of social networks aims to define local structures by identifying the relationships between the groups that represent the nodes. Protagonists of the cluster at the basis of the cooperation and coordination of territorial areas include tour operators, SMEs, institutional stakeholders of the local population and in general of the actors involved in sectors of the tourism dimension. The models to be defined require the cross-experimentation of different approaches oriented towards the evaluation of the system and services, incorporating different thematic areas. The models that are intended to be defined first in each individual thematic area will then be structured through a specific relationship between them. The result, tested, aims to reconstruct the situation before and after the tourist intervention in selected areas. The models thus intend to pursue the following guidelines: (i) the enhancement of local resources in the productive, environmental and cultural sectors; (ii) the materialization of opportunities for social and economic promotion rooted in the dimension of places; (iii) the protection of the environment and socio-ecological characteristics. The ecosystem is distinguished by the characteristics of adaptability and transdisciplinary based on the project of the relationship typical of tourism.

4 Conclusions

The research contributes to the definition of "tourist ecosystem" based on the targeted organization of the territorial tourist offer.

The emerging approach in tourism development based on the concept of tourism ecosystems represents a promising prospect for enhancing local approaches and applications within the paradigms of the NUA 2030 agenda. Compatibly with the objectives of the PNRR - tourism transition 4.0 - the outcome of the evaluation structures the network relationship between the actors of the tourism chain involved. The goal is to outline a methodology capable of anticipating and monitoring the results of governance choices made by measuring the impact on the social, environmental and economic components.

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The definition of "tourist ecosystem" represents a first step in a complex research project oriented to define effective and ready to market models for planning and design sustainable tourism development scenario for in-land areas. The research perspective adopts an operative approach based on data driven model for territorial tourism stock assessment defining minimum requirement for a "tourism ecosystem" according to a comparative analysis benchmarking minor and major tourist destinations. Implications regards several territorial planning domains (Pilogallo & Scorza, 2022; Santopietro & Scorza, 2021; Scorza, Pilogallo, et al., 2020; Scorza, Saganeiti, et al., 2020; Scorza & Fortunato, 2021, 2022; Scorza & Santopietro, 2021) directly and indirectly connected with tourism sector.

Future implications include:

- the development of territorial models in order to provide decision support systems (DSS) useful for implementing investment plans, programs and projects in the medium-long term in line with the objectives of sustainable local development. The design of data-driven models is based on different levels capable of identifying the alternative that best suits the specific territorial needs for both the public sector and private operators (Corrado et al., 2023);
- analysis and implementation of spatial data infrastructures essential for the evaluation of tourist services and the monitoring of territorial processes;
- the collection of information to reconstruct an exhaustive dataset represents a first phase to guide future developments effectively. In accordance with the envisaged models, it is necessary to characterize an integrated survey methodology aimed at illustrating the impact that tourist services have on the territory.

This framework is a component of a larger research project called "Tech4You" that implements national strategies for rebalancing the growth of Southern areas.

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micro/macro tourism systems through the implementation of AI models at territorial scale, prof. Francesco Scorza)

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Strategic Knowledge Management as a Key Driver for Social Innovation Deployment

Oscar Alejandro Espinoza Mercado*

Universidad de Guadalajara
Periférico Norte N° 799, Núcleo Universitario Los Belenes,
Zip code 45100, Zapopan, Jalisco, México.

Jorge Pelayo Maciel

Universidad de Guadalajara
Periférico Norte N° 799, Núcleo Universitario Los Belenes,
Zip code 45100, Zapopan, Jalisco, México.

** Corresponding author*

Abstract

Nowadays, innovation has become the staple of every company. The nature of global economic growth has also been modified by the high speed of innovation, due to a very distinctive rapid and everlasting evolving technology, shorter product lifecycles, programmed obsolescence and a higher rate of new product development. Companies, institutions and organizations have to make sure or even guarantee that their business strategies are unique and innovative in order to build and sustain competitive advantage, otherwise they would simply die.

It is important to stand out that strategic knowledge management processes are quite significant for innovation, since they conceive knowledge creation, knowledge transfer and knowledge application. It all aims to create a unique knowledge resource that can eventually be added into products, processes and services (Nonaka & Takeuchi, 2009). The main purpose of it is contributing towards improving social well-being, enhancing economic growth as well as improving technological readiness (Kanter, 2015). In this sense, the current study aims to identify and analyse the key drivers for social innovation deployment. Chiva et al. (2014) state that knowledge is widely regarded as a new novel solution for a wide range of issues which have been wracking havoc all around the world.

On the one hand, there is a widespread agreement among authors, researchers, consultants and thinkers in the field of management. When it comes down to innovation, they all posit that it is the central capability for all organizations and they are all interested in it. It is all about doing different things with the same elements. On the other hand, social innovation turns out to be a vital outcome since it is related to providing a better understanding and results to global issues.

These two concepts must be considered to fully understand the abovementioned intrinsic relationship. The latter does not only solve specific problems, but also encourages collective action and inclusion.
To sum up, the current study aims to delve into these concepts and their contribution to science, technology and society. Once key drivers have been identified and analyzed, a theoretical methodology will be applied and interpreted through a thorough examination. By doing this it will also be important to determine the degree of importance so that data can be properly easily understood.
Finally, it is worth to mention that the output is expected to be disseminated in order to enhance practical scenarios facing up current circumstances regarding social innovation.

Keywords – Strategy, knowledge management, social innovation

1 Theoretical framework

Knowledge management and social innovation are two important concepts that have emerged in recent years. While they may seem unrelated at first glance, they are actually closely linked and can have a significant impact on organizations, communities, and society as a whole.

Knowledge management is typically thought as the process of identifying, capturing, sharing, and effectively using knowledge and information within an organization. It involves creating and maintaining an environment in which knowledge can be easily accessed, shared, and utilized to improve business processes, products, and services. The goal of knowledge management is to enhance the efficiency and effectiveness of an organization by leveraging the collective knowledge and expertise of its employees. Still, it is not only restricted to organizations.

In order to understand this concept it is necessary to take a deep dive into several conceptions. López- & Meroño (2011) argued that despite considerable advances in certain aspects, heterogeneous and confounding results had been presented related to the variables affecting knowledge management programs. Duhon (1998) defined knowledge management as an integrated approach that aims to identify, capture, evaluate, retrieve, and share all information, and this information can take the form of databases, documents, policies, procedures, or formerly uncaptured expertise and experience among individual workers. Knowledge management was also observed as a process of creating, acquiring and transferring knowledge reflected in the behavior of the firm, which turns out

to be valuable (Bueno et. al., 2010). Basically, it is all about gathering and systematizing companies´ assets.

1.1 Strategic knowledge management

According to Hill (2023), strategic knowledge management is a plan of action that outlines how your organization will manage and centralize company information, data, and knowledge to improve the productivity and efficiency of an organization. The most successful of these strategies are closely aligned with company-wide goals and objectives. A knowledge management framework should actually incorporate a basic understanding of knowledge operations and infrastructures in order to support operations. According to Lee and Choi, knowledge management enablers are mechanisms that are employed by firms to foster consistent knowledge usage. By doing so, firms, organizations or companies make sure they keep the whole valuable data that could eventually be disseminated (Lee & Choi, 2003). Knowledge management refers to identifying and leveraging the collective knowledge in a firm (Krogh, 1998), but there is still a problem regarding the integration of such knowledge into a firm's strategic levels. The main difficulties for firms regarding sustainable development include the potential failure of knowledge management due to the difficulty of integrating the knowledge at the strategic level (García et al., 2010); hence, the ability of firms to identify, codify and leverage/use their knowledge sources as a firm strategy to increase overall performance and competitive advantages is limited. Hence, strategic knowledge management needs to be formulated as a set of measures at a firm's strategic level. This is the main idea of the current study, since they must be aware about the enormous challenge they have to cope with if it can be well handled.

1.2 Social innovation definition

According to OECD (2023): "Social innovation refers to the design and implementation of new solutions that imply conceptual, process, product, or organisational change, which ultimately aim to improve the welfare and wellbeing of individuals and communities."

Several initiatives undertaken by civil society and the social economy have proven innovative in dealing with environmental and socio-economic issues while

contributing to economic development. To support public, non-profit, and private actors to co-construct and implement socially innovative solutions and thereby contribute to addressing socio-economic issues, build stronger territorial resilience, and better respond to future shocks, it is necessary to fully tap the potential of social innovation, an enabling policy framework is needed.

Social innovation, refers to the development and implementation of new ideas, products, services, and practices that aim to address social and environmental challenges. It involves identifying and addressing social needs and creating new solutions that can bring about positive social change. Social innovation can occur at the individual, organizational, or community level, and it often involves collaboration and partnerships between different stakeholders.

Once social innovation has been understood, it is important to get deeper into the innovation strategy, which also gets involved into these dynamics. The outcome of innovation strategy is regarded as the vital ingredient to produce superior products, processes and services which in turn stimulates economic and social growth.

1.3 Why is important the relationship between strategic knowledge management and social innovation?

Strategic knowledge management can help organizations collaborate and share knowledge. Collaboration is key to social innovation, and knowledge management can facilitate this collaboration. By creating knowledge-sharing platforms, organizations can connect with other stakeholders, including communities, NGOs, and government agencies. These platforms can be used to share knowledge, best practices, and resources, leading to the development of new solutions and innovations. For example, a group of NGOs may use a knowledge-sharing platform to collaborate on a project that aims to address the issue of climate change.

By developing a culture of learning and innovation, organizations can create an environment that supports social innovation. This culture can be supported by knowledge management practices, such as training and development programs, which can help employees develop the skills and knowledge needed to develop innovative solutions. For example, a social enterprise may offer training and development programs to employees, helping them to develop the skills needed to develop new products and services.

Additionally, strategic knowledge management can help organizations measure the impact of social innovation. By collecting data on the outcomes and impact of social innovation, organizations can understand what works, what doesn't, and what needs to be improved. This knowledge can be used to refine and improve social innovation initiatives, leading to better outcomes for communities and the environment. For example, an NGO may use data analytics to measure the impact of a social innovation initiative aimed at addressing poverty in a specific region

In conclusion, strategic knowledge management can serve as a key driver for social innovation.

By identifying needs, facilitating collaboration, building capacity, and measuring impact, organizations can use knowledge management to develop innovative solutions to social and environmental challenges. In a world where social and environmental challenges are becoming increasingly complex, strategic knowledge management can help organizations create positive social change and build a more sustainable future.

Having said that**,** knowledge management and social innovation are intertwined because effective knowledge management can help drive social innovation. When organizations have access to valuable knowledge and information, they are better equipped to identify social needs and develop innovative solutions to address them. Similarly, social innovation can lead to new knowledge and insights that can be captured and shared through knowledge management processes. One example of how knowledge management can support social innovation is through the use of data analytics.

By collecting and analyzing data, organizations can gain valuable insights into social needs and trends, which can help them identify areas where social innovation is needed. These insights can be used to develop new products, services, and practices that can help address social challenges.

To make it clear, knowledge management and social innovation are two important concepts that can have a significant impact on organizations and society as a whole. By leveraging knowledge and expertise, organizations can drive social innovation and create new solutions to address social challenges.

2 Methodology

In order to keep on going with the proposed analysis, the methodological parameters are presented. These parameters guided the development of the

current research, with a focus on achieving and responding to the set objective. According to Gil (2008), a research can be classified as to the nature, the objectives and the means of searching the data. The current study is qualitative as to the nature, since it attempts to provide with a better understanding of the facts sought from the contents found in the literature review (Oliveira, 1999). The objective is exploratory, since it aims to gather information and to describe how the phenomenon occurs. As far as data collection and analysis are concerned, it is an integrative literature review, with the purpose of synthesizing results gotten in researches on a theme or question, in a systematic, orderly and comprehensive way (Ercole et al., 2014). For the preparation of the integrative review, six steps were followed: 1) elaboration of the guiding question starting from the question; 2) inclusion and exclusion criteria; 3) identification of pre-selected and selected studies; 4) categorization of the selected studies; 5) analysis and interpretation of the results, and finally 6) presentation of the knowledge review (Botelho et al., 2011). Table 1 presents the steps and their description.

Table 1 - Stages of the Systematic Review

Steps	**Description**
1) Elaboration of the guiding question	The guiding question of the research is: "How does strategic knowledge management impact on social innovation deployment?"
2) Inclusion and exclusion criteria	To search the literature, a survey was carried out on the following databases: Web of Science, Ebsco, Scopus, Emerald and Scielo. In the procedure, the survey fields "Titles, Abstracts and Key words", with the following descriptors and their combinations were used: "Strategic Knowledge Management" and "Social Innovation". The total of articles downloaded from the databases was 32. As for the content exclusion criteria, were selected only empirical articles that presented results obtained through the application of field research, thus discarding articles only theoretical. After this exclusion, only 8 articles were left for in-depth content analysis.
3) Identification of the pre-selected and selected studies	Based on the research question, it was sought to identify in the articles the similarities between the objectives and the main results.
4) Categorization of Selected Studies	Based on the identification of the pre-selected studies, it was sought to categorize them as to the coherence of knowledge management in social innovation
5) Analysis and interpretation of results	With the categories grouped together, it began the identification of which knowledge management initiatives were focused on each one of them.
6) Presentation of the knowledge review	The presentation of the review shows the interpretations and the results of the research based on the integrative analysis of the data of the articles.

Source: Adapted from Botelho et al., 2011.

3 Interpretation

In accordance to Nonaka & Takeuchi, (1995) in an economy where the only certainty is uncertainty, the one sure resource of lasting new innovation and competitive advantage is basically knowledge resource. Based on the previous statement, the current study attempts to explore the association of strategic knowledge management processes with social innovation. As far as it goes to the literature review, strategic knowledge management can be conceived as the ability to identify, create, harness, transfer, integrate and apply superior knowledge resource resident in the individuals, teams or organizations that involves wide range of activities and interactions to improve and creates new innovation. If so, it is would be worth it to mention that a good example would be quality products, processes and services which is the key aspect of competitive advantage and to fulfil social needs (Meier, 2011).

At this point, it is also important to stand out the fact that strategic knowledge management creates three prominent processes namely:

- Knowledge creation
- Knowledge transfer
- Knowledge application

To be more specific, knowledge creation is associated with the development of new knowledge (Gourlay, 2006). Knowledge transfer refers to the whole transmission process whereby knowledge is transferred within or across organization boundaries (Argote & Ingram, 2000). At last but not least, knowledge application is described as how such knowledge is embedded and applied to create value, new innovation and competitive advantage (Grant, 1996). These three processes of strategic knowledge management provide superior knowledge resource that can be embedded into products, processes and services according to Nonaka & Von Krogh (2009).

As it has already been stated, the new paradigm of social innovation is defined as a new and novel solution that can be embedded into any given products, processes and services in order to fulfil social, economic and technological needs and to improved quality and quantity of people's life (Altuna et al. 2015). This conception does not go farther from providing quality of life. From the above statement, in ensuring the success of social innovation as an outcome innovation strategy there must be a presence of a new and novel solution. Battisti (2012) and Makimattila et al. (2015) describe the innovative kind of solution which is the

main element of social innovation that refers to the superior knowledge resource. This superior knowledge resource is embedded into products, processes and services which make them highly innovative and in turn lead to the outcome of improving the quality and quantity of people's life, stimulate economic growth and enhance technological advances (Unceta et al., 2016).

Furthermore, the creation of superior knowledge resource is within the processes of strategic knowledge management namely; knowledge creation, knowledge transfer and knowledge application (Audretsch & Cajazza, 2015). In addition, according Van Wijk et al. (2008), university-industry partnership is the strategic platform to implement strategic knowledge management processes in producing superior knowledge resource. To show evidence, Kanter (2015) states that, social innovation helps to improve societal, economic and commercial related problems by creating new knowledge resource which acts as a novel solution into products, processes and services that work to meet pressing social, economic and technological needs and to improve quantity and quality of people's life.

As a matter of fact, an empirical finding by Surikova et al. (2015) established that in the aspect of poor public education system, social innovation offers new solutions i.e. superior knowledge resource; that contributes to a better future knowledge worker. Scheuerle et. al. (2015) also revealed that the result of deployment of superior knowledge resource within social innovation outcome on the issues of massive unemployment, contributes towards increase in employment among people and also increase in consumption of economic benefits. Moreover, Cajaiba-Santana, G. (2014) and Spiess et al. (2015) highlighted that social innovation with the presence of superior knowledge resource leads to the introduction of superior products, processes and services that have a multiplier effects on the economic value in terms of profit maximization, market share monopoly and increase in private performance. El Arifeen et al. (2013) also stressed all of the positive effects of social innovation and knowledge resource on the issues of social health.

In contrast, Cajaiba-Santana (2014) provides another approach of social innovation since he conceives it a bit differently. This is the next academic article to review the growing interest in social innovation, suggesting there exist two main approaches to social innovation: agentic-centred (closely related to the literature on social entrepreneurship and the role of the individual 'hero' change agent), and structuralist (referring to the social structures in which these agents

operate). While the review is less systematic and uses a mix of sociological and institutional theories, it does importantly suggest the connection between social innovation and institutional change, and the necessary interactions between structure and agency to make this happen. Two years later, Van der Have & Rubalcaba (2016) conduct a more systematic network and bibliometric analysis of the expanding scholarly literature on social innovation, focusing on the relationship to innovation studies more generally. They suggest social innovation is more of an innovation paradigm than a separate category of innovation, referring to 'a large revitalization of the social aspects involved in any kind of innovation, technological innovation included' (Van der Have & Rubalcaba, 2016).

As a popular and expanding concept, some early reviews of social innovation highlighted the diversity of disciplines interested in the topic and a consequent and growing fragmentation around the scope and meaning of social innovation (Cajaiba-Santana, 2014; Edwards-Schachter & Wallace, 2017; Phillips et al., 2015); Silveira & Zilber, 2017); Van der Have & Rubalcaba, 2016; see Chapter 1?). Many early definitions tried to encompass a variety of views, often sociological in nature and incorporating aspects of both structure and agency (Van der Have & Rubalcaba, 2016). Reviews include Silveira & Zilber's (2017) bibliometric analysis of social innovation, Van der Have & Rubalcaba's (2016) network and bibliometric analysis, Cajaiba-Santana's (2013) structural and institutional summary of social innovation, and content analysis of key terms and understandings associated with social innovation.

In Pol & Ville's (2009) early review and discussion of the term, they describe its mixed emergence in varied academic but especially practitioner literature (as noted in definitions above). This review highlights the concept of social innovation as being related to institutional change, social purposes, the public good, and not necessarily delivered by market mechanisms (as social innovation is often perceived as addressing needs that have been ignored by the market). Pol & Ville (2009) describe social innovation in comparison to business innovation, offering a more economic conceptualization: where the former pursues social impact, the latter pursues increased profitability.

Once these approaches have been considered, it is important to stand out the role of strategic knowledge management, since it can be such a powerful tool for driving social innovation. It is well known that by effectively capturing, sharing, and leveraging knowledge, organizations can develop innovative solutions to social and environmental challenges. This is the reason why the theoretical study

explores how strategic knowledge management can serve as a key driver for social innovation.

Firstly, strategic knowledge management can help organizations identify social and environmental needs. By collecting and analyzing data, organizations gain valuable insights into social trends, needs, and challenges that have already occurred in our daily lives. This information can be used to identify areas where social innovation is needed, as well as to develop new solutions to address these challenges. For example, a social enterprise working on renewable energy may use knowledge management to identify trends in the market and develop "new products" that meet the needs of customers and future generations (Flores-López et al., 2023).

Secondly, strategic knowledge management can help organizations collaborate and share knowledge. Collaboration is key to social innovation, and knowledge management can facilitate this collaboration. By creating knowledge-sharing platforms, organizations can connect with other stakeholders, including communities, NGOs, and government agencies.

Thirdly, strategic knowledge management can help organizations build capacity for social innovation. By developing a culture of learning and innovation, organizations can create an environment that supports social innovation. This culture can be supported by knowledge management practices, such as training and development programs, which can help employees develop the skills and knowledge needed to develop innovative solutions. For example, a social enterprise may offer training and development programs to employees, helping them to develop the skills needed to develop new products and services.

Finally, strategic knowledge management can help organizations measure the impact of social innovation. By collecting data on the outcomes and impact of social innovation, organizations can understand what works, what does not, and what needs to be improved. This is something that already happens everyday. Also, this knowledge can be used to refine and improve social innovation initiatives, leading to better outcomes for communities and the environment.

In a world where social and environmental challenges are becoming increasingly complex, strategic knowledge management can help organizations create positive social change and build a more sustainable future. In order to support such a statement, the following data is presented:

- In 2021, the Global Innovation Index (GII, 2022) reported that social innovation is gaining importance as a driver of economic growth and

social well-being. According to the GII (2022), social innovation is particularly important for addressing social challenges such as poverty, inequality, and climate change.

- In 2021, the European Commission reported that social innovation is increasingly recognized as a key driver of social and economic progress. The Commission noted that social innovation has the potential to create new solutions to complex social problems, drive social entrepreneurship, and foster inclusive growth.
- According to Schwab Foundation for Social Entrepreneurship Report (2019), social innovation is growing rapidly around the world. The report found that social entrepreneurs are emerging in all regions, with a particular focus on areas such as healthcare, education, and sustainable development.
- The Ashoka Globalizer program, which supports social entrepreneurs in scaling their impact, reported that its alumni organizations have collectively impacted over 100 million people in more than 90 countries around the world.

4 Conclusions

At the end of this study, the goal was achieved, since it was possible to present, by means of reviews, dissertation and discussions, the set of strategic knowledge management traits that impact on social innovation actions. As to the goals and main results of the articles analyzed, it can be observed that, in general, knowledge management turns out to be a key driver for a suitable social innovation development. It is important to stand out the fact that there are many contexts where this interconnection takes place: social, economic, technological applications play a supporting role in knowledge management for these kinds of actions. In addition, it should be emphasized that social innovation actions bring a strong bias of cooperative work and attendance to social needs and in this way knowledge management should be attentive to how collective knowledge can be acquired, processed and how it can generate value and contribute to the abovementioned actions.

It was noticed that the knowledge management considerations are normally more focused on the improvements of processes and the use of technologies. As for innovation, it is worth to highlight the cooperative and collaborative work

among the players of social innovation, and the knowledge management tools. As Far as it goes to the use of technologies, there is a special emphasis on open technologies with free access by societies. The motivational and flexibility factor to improve productivity and decrease the costs of public organizations is crucial. For future work, it is proposed a more in-depth study of strategical knowledge management concerning how people learn and what motivation can be related to social innovation in different communities, since people can be considered as a key point both in knowledge management and in social innovation actions. That study could actually be justified by the objective of improving social innovation and better understanding how the collaborative networks created in these dynamics from the point of view of knowledge generation.

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Learning Spaces Based on Advanced Technologies: Towards a Management and Assessment Tool

Rosaria Lagrutta*

Department of European and Mediterranean Cultures
University of Basilicata
Via Lanera, 75100 Matera - Italy

Daniela Carlucci

Department of European and Mediterranean Cultures
University of Basilicata
Via Lanera, 75100 Matera - Italy

Giovanni Schiuma

Department of Management, Finance and Technology
LUM University Giuseppe Degennaro
S.S. 100 km 18 – 70010 Casamassima (Bari) – Italy

Francesco Santarsiero

Department of Matematics, Computer Science and Economics
University of Basilicata
Via dell'Ateneo Lucano, 10, 85100, Potenza - Italy

Antonio Lerro

Department of Matematics, Computer Science and Economics
University of Basilicata
Via dell'Ateneo Lucano, 10, 85100, Potenza - Italy

** Corresponding author*

Abstract

The increasingly complex and uncertain socio-economic scenario and the new challenges and opportunities of the digital revolution are forcing organizations to anticipate changes and boost more and more their innovation processes in order to maintain their competitive advantage. In such scenario, are emerging new spaces of action and interactions based on tangible and intangible elements that influence learning and knowledge processes and dynamics. These innovative learning spaces include a

combination of elements enhancing the learning process, with a strong technological component. In such a context, how to manage and assess the effectiveness of learning spaces, especially based on advanced technologies, has become a key topic. Despite that, to date, how to assess the effectiveness of learning spaces remains under-investigated.
This study proposes a conceptual framework that highlights the relevant variables and dimensions to assess in a learning space. For this purpose, the study adopts a systematic literature review approach. The theoretical findings suggest specific variables and dimensions to consider in assessing learning spaces, especially the ones supported by advanced digital technologies. Moreover, the paper provides managers with a conceptual framework supporting the decision-making process in managing and assessing LS.

Keywords – Learning spaces, Advanced technologies, Knowledge management, assessment, conceptual framework.

Paper type – Academic Research Paper

1 Introduction

In the current complex and uncertain socio-economic scenario, and thanks to the new challenges and opportunities of the digital revolution, organizations have to know ho to boost more and more their innovation processes and anticipate changes, in order to maintain their competitive advantage. In such scenario, learning spaces are acquiring growing importance. (Alstete and Beutell, 2018) A LS is a space of action and interactions based on tangible and intangible elements that influence learning and knowledge processes and dynamics.

Before the pandemic, public and private organizations mostly used physical learning spaces, even if digital transformation was already taking hold. Pandemic has acted as an accelerator, resulting in the adoption of virtual methods or digital technologies, basic and advanced by most organizations.

Innovative learning spaces include a combination of elements enhancing the learning process, with a strong technological component. Recently, public and private organizations have experimented more advanced technological tools, such as virtual reality, augmented reality, artificial intelligence and metaverse.

Given the new emphasis on the relevance of these kind of spaces, how to assess their performances and effectiveness has become a key topic that is gaining growing attention. (Karam et al., 2021; Krishnamurthy, 2020; Grigol et al., 2014).

Despite this, performance assessment of learning spaces remains under-investigated. In this vein, this study proposes a conceptual framework that highlights the relevant variables and dimensions to assess in a learning space.

In particular, the study tries to answer the following research question (RQ): What are the dimensions of a learning space? For this purpose, from a methodological point of view, the study carries out a systematic literature review aimed at filling the dimensions of the spaces with the components to consider for the evaluation. A conceptual framework is then developed, with a specific focus on the technological dimension.

The framework's purpose is to guarantee and enhance the effectiveness of a LS, and specifically a learning space based on advanced technologies. In this vein, it supports the identification of the relevant dimensions of a LS that should be evaluated in an ex-post perspective.

The model, indeed, includes five main pillars, composing the infrastructure of a LS i.e. i) physical setting; ii) technological dimension; iii) organizational resources; iv) actors and interactions and v) culture and atmosphere.

The research results synthesize data and knowledge gathered from the systematic literature review and offer implications and insights both for theory and practice. The findings suggest specific variables and dimensions to consider in assessing learning spaces supported by advanced digital technologies.

The paper is organized as follows. In the next section, the methodology of analysis is described. Then, the essential dimensions to consider for a holistic assessment of LS based on advanced digital technologies are identified and described. Finally, theoretical and practical implications, as well as future research directions are illustrated.

2 Research Methodology

The management literature provides a vast amount of data and articles and analyzing them is a challenging task, especially in the phase of systematization and summary of the contributions and one of the responses is to undertake an extensive analysis of the contributions in the literature. In particular, for the purpose of this study, a systematic literature review has been carried out, adopting the approach proposed by Tranfield et al. (2003), which is a scientific and transparent process, reported in sufficient detail to permit the replication. (Tranfield, 2003), and balanced in terms of specificity and sensitivity (The

Cochrane Collaboration, 2017). With a SLR approach, insights and evidences from the literature have been found, synthetized and evaluated (Calabrò et al., 2019; Cillo et al., 2019).

Tranfield et al. (2003) proposed three main phases (planning the review, conducting an inspection, reporting and disseminating) and outlined nine sub-phases.

In the first stage, keywords and searching terms have been established to carry out the SLR. The search strings were defined according to the research question: "What are the dimensions of a learning space?".

Given the plurality of terms used interchangeably to refer to learning spaces and dimensions, a broader selection requirement has been adopted to include all the significant studies. The key selected research strings are "learning space" OR "learning environment" AND "components" OR "characteristics" OR "dimensions" OR "features". The search strings chosen in this specific case are wide enough to allow the understanding of the level of knowledge and contributions in this field and to identify the areas to explore.

Generally, there are different paths for searching data using strings and keywords through an appropriate algorithm; i) choosing a single database (Cillo et al., 2019); ii) choosing multiple databases (Hossain, 2019) or iii) focusing on the existing literature of the article selection and engage experts that suggest significant works to be referred to (Crossan and Apraydin, 2010).

With the scope of building a holistic and comprehensive understanding of the dimensions of learning spaces, the approach proposed by Hossain et al. (2019) has been adopted. Specifically, the multiple databases considered were Web of Science (WoS) and Scopus, acknowledged as complete databases for academic papers (Falagas, 2008). The final set of works to be considered has been defined, identifying all relevant articles and removing duplicate papers.

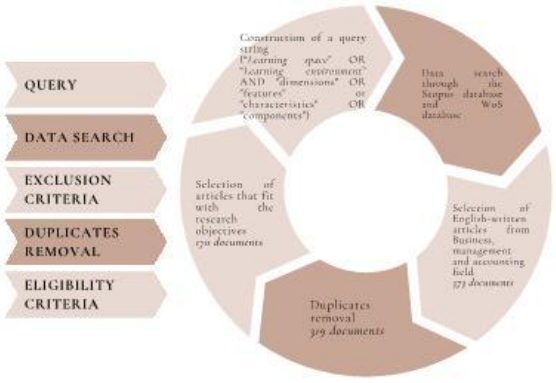

Fig. 1 - Steps of the research process and number of selected papers

Predetermined criteria were chosen to decide what literature to include or exclude: filters were applied to include articles already published in journal from *2009 to 2023*, the research field of interest was *Business, Management and Accounting*. Conference papers, articles not written in English, book chapters, and special issue editorials were excluded. All duplicate papers from different sources were identified and removed.

Titles, abstracts and keywords of the remaining 373 articles were analysed to include contributions aligned with the aims and focus of the analysis.

In fact, other exclusion criteria are chosen after a first scan of the essential article source information, and concern the consistency between the article topics and the research questions.

Figure 1 depicts the steps of the systematic review process and the number of selected studies on each step. Following our interpretative lenses to synthesise the extracted data, the insights extracted by the articles were organised according to the different dimensions of a learning space emerged from the literature.

3 Analysis of the results

3.1 Background: learning spaces based on advanced technologies

Learning spaces are physical or virtual place where people interact cooperatively, to generate, manage and exchange knowledge, acquire skills and encourage opportunities for brainstorming, idea generation and problem-solving that may trigger innovation dynamics. The goal of a learning space is to support processes of skills development, triggering the development of an innovative

capacity through the management of knowledge and learning dynamics. Therefore, the concept of learning space may be associated with all those organizational and territorial contexts aimed at developing the organizational basic, distinctive, and dynamic skills. It is a multidimensional space that includes different factors, characteristics and dimensions, such as physical, social and cognitive characteristics, and technological, cultural, emotional, intellectual, and relational dimensions. (Dleikan et al., 2020; Jens and Gregg, 2022)

The reorganization of spaces oriented towards the learners and the learning process, gave emphasis to the diffusion of LS supported by advanced tools.

Specifically, the pandemic has forced public and private organizations to shift from in-person to virtual teaching and learning. COVID-19 has altered the educational and training landscape and forced learning and training environments to quickly evolve to meet new unexpected challenges and to fully exploit digital technologies and advanced digital technologies. Indeed, the digital transformation in education and training and the creation of more advanced learning spaces are not new, the pandemic has just given a new emphasis on their usefulness. (Karam et al., 2021; Krishnamurthy, 2020). A learning space based on advanced technologies does not guarantee effective learning processes per se; learning and knowledge dynamics must be integrated with the choice of suitable technological tools. In this regard, new digital technologies have the potential to become powerful and potential changing agents and strategic allies for sustainable and inclusive development of innovative, cheaper and more user-friendly learning spaces and effective knowledge creation and exchange. But the technological dimension is not the only one to consider for managing and assessing a learning space. There are other dimensions, such as the relational one, that involve actors having heterogeneous skills, and the atmosphere that promotes cooperation between the actors and should be free of hierarchical constraints and judgment. These infrastructural dimensions have to sustain learning and knowledge dynamics, with the aim to positively influence the innovative capacity of the organization. In conclusion, according to the researchers, these spaces enable and catalyze knowledge and learning dynamics, supported by a tangible and intangible infrastructure and a strong technological component that enables open, honest, and receptive interactions among the stakeholders involved. In conclusion, a learning space represents a distinctive element for public and private organizations, and it is a factor enabling innovation dynamics. Today's companies need more and more to improve and

foster their processes of knowledge creation, sharing and transfer and properly managing learning spaces. (Nonaka and Tacheuchi, 2019)

In this vein, the dimensions characterizing a learning space and their components, are analysed more in depth in the following. The output is a conceptual framework. The framework has a dual purpose, descriptive and prescriptive, and aims to guarantee and enhance the effectiveness of an innovative learning space. In this vein, it supports the identification of the relevant dimensions that should be evaluated in an ex-post perspective.

3.2 Infrastructure of a learning space

As already mentioned, learning spaces enable and catalyze knowledge and learning dynamics, supported by a tangible and intangible infrastructure that fosters open, honest, and receptive interactions among the stakeholders involved. (Delgado et al, 2020)

3.2.1 Physical setting

Learning spaces emerge as places where learning and knowledge dynamics are activated and supported. The management literature has highlighted the influence that the physical setting has on dynamics, interactions, and processes, as well as on individuals' skills development and behavior definition. In consequence, attention to detail is essential to positively impact the learning space's effectiveness.

The physical setting of a learning space refers to the physical space or spaces in which learning happens. (Sankari et al, 2018)

The physical setting includes individual and common spaces. Scholars have discussed some key characteristics of such spaces which are furniture, seating arrangements, lighting, temperature, decorations, and acoustics. (Sasson et al, 2021) Furniture facilitating the interactions between actors, tools, and the environment is preferred while the quality of the air, luminous color, and light can help develop a favorable and stimulating learning space. (Dleikan et al., 2020; Jens and Gregg, 2022)

Generally, the design of an effective learning space favors engagement, creativity, and collaboration with a high level of comfort and flexibility. All the design elements characterizing the space must merge into a synergistic whole.

(Heiskanen & Heiskanen, 2011)

3.2.2 Technological resources

The technological resources dimension contemplates a combination of technological tools and infrastructures that contribute to the enhancement of the learning and knowledge processes and dynamics. Different technological tools can foster or prevent impacts on the learning processes. In consequence, the design and management of a learning space must be associated with the choice of the appropriate tool to use, to exploit their potential and maximize the value added. (Delgado et al, 2020)

According to the literature, the technological dimension is considered a key factor in the success of learning space, as it enables learners to access a wide range of educational content and resources and to engage in active, experiential, and collaborative activities. They provide individuals with means for representing knowledge in multiple ways. (Sasson et al, 2021)

The literature discussed the use of various technological tools; in particular supporting and basic tools and advanced and 4.0 technologies. Examples of basic technological assets and software supporting learning and knowledge dynamics are platforms, computers, mobile phones, tablets, projectors, eReader, 3D printers, headphones, digital watches, digital whiteboards, and so on. (Latrous & Khadraoui, 2020)

Concerning more advanced technologies, they can contribute to the enrichment of learning, enhancing the learning strategy and institutionalizing continuous learning and the protocol for sharing and transforming knowledge. Some representative examples pointed out in the literature are Artificial intelligence, Internet of Things (IoT), augmented and immersive reality, digital platforms, metaverse, sensors, algorithms, adaptive learning platforms, and other smart technologies, that facilitate interaction and collaboration in the learning process. (Abdalina et al., 2022; Diaz Tito et al., 2021)

One of the latest and recent development in this direction is Metaverse, that was born from the convergence of two ideas, specifically VR and second life. Within a Metaverse, actors can interact, meet, socialize and work through digital avatars or holograms.

Learning spaces based on advanced technologies can have different benefit as well as several barriers to consider to maximize the potential of the digital tool implemented. Some example of potential benefits are:

1. the immersive nature of the experience;

2. the ability to work virtually in remote or unsafe environments;
3. the flexibility of the approachç
4. a remarkable, amazing learning experience that may be exciting, fun and enjoyable. (Snieder and Zhu, 2020; Hines and Netland, 2022)

However, different researchers also acknowledge the limitations of technology, such as the need for effective data processing, the potential for technology to create a sense of isolation and disconnection among learners and negative effects on the user such as dizziness or headaches. In this vein, the individuals involved in a learning space have to best integrate the technologies into the functioning mechanisms of the space. (Snieder and Zhu, 2020; Hines and Netland, 2022)

3.2.3 Organizational resources

This dimension includes the tangible and intangible resources that support learning processes and knowledge dynamics, within a learning space.

Specifically, it includes methodologies, contents, materials, and resources available to support learning. Learning methodologies are systems of practices and procedures that providers of knowledge employ to develop a learning process. Some examples of methodologies may be project/problem-based learning, design thinking, storytelling, collaborative communities, web-based videos, narrated stop-motion animation, modeling, gamification, simulation, flipped classrooms, content-driven processes etc. (Filippou et al., 2018;; Maheshwari & Seth, 2019)

According to the literature, a key aim for the development of new learning spaces is to understand what methodologies support and favor the introduction of technologies.

On the other hand, topics are themes, concepts, and facts, often grouped into subjects, that are expected to be learned. (Aggarwal, 2017; Akhmetshin et al., 2019)

Schobel & Scholey, (2012) identify other important organizational resources that are economic resources and specifically the financial strategies adopted. The authors argue that learning spaces with well-defined financial strategies are linked to positive outcomes and are well-positioned for success.

3.2.4 Actors and interactions

The success of a learning space strongly depends upon the actors, how they are engaged within the facility, and how they interact with each other.

The nature of people or users involved in learning spaces is vast. According to the literature, two types of knowledge actors can be identified in a learning space: providers of knowledge and learners. Learners can be an internal or external target, some examples are students, managers, organizations, employees, and staff. On the other hand, providers are people supporting learners, acting as coordinators who facilitate the interactions and the exchange and development of knowledge. This role may coincide with teachers, professors, transformative leaders, innovation managers, researchers, mentors, entrepreneurs, facilitators, organizers etc. (Stern et al, 2020; Pawlowsky et al, 2020; Nonaka and Takeuchi, 2019; Sankari et al, 2018)

The actors' interaction concerns the system of interactions between internal and external actors that take place in the learning environment. According to the literature, the design of the learning space has to promote positive relationships and a sense of belonging. (Abuhassna et al., 2022)

Learners and providers continuously engage with each other and with the learning space. The interactions can be horizontal, vertical, and external. Horizontal and vertical interactions can take various forms, such as verbal communication, written communication, scaffolding, collaboration activities, feedback, and reflection. In a physical setting, interactions may occur through face-to-face discussions and group work, whilst in an online learning environment, interactions may occur through discussion forums, video conferencing, and other digital communication tools.

Effective interactions require active participation, mutual respect, and a willingness to engage in constructive dialogue and feedback. (Delgrado et al, 2020)

3.2.5 Culture and atmosphere

This dimension identifies the mood, attitudes, expectations, practices, norms, and sensorial qualities distinguishing a learning space. It influences the effectiveness of the space, increasing or preventing motivation, attention, creativity, and the level of involvement of people. A learning space includes constructs concerning the experiences lived by the individuals involved,

influenced by their own behavior. The quality of a learning space is strongly influenced by the nature and orientation of the actor's culture. (Pawlowsky et al, 2020) A positive learning environment promotes open-minded culture, flexibility, and willingness to engage in innovative activities. It provides opportunities for learners to explore new ideas and concepts, and to develop critical thinking and problem-solving skills. (Burusic, 2019) Together with the actor's culture, also development of a strong knowledge culture is a key determinant of the learning space's effectiveness. (Abuhassna et al., 2022; Csizmadia et al., 2022; Karkoulian et al., 20132)

The atmosphere of a learning space refers to the shared values, beliefs, attitudes, and behaviors of the individuals who participate in the learning process. It includes the norms and expectations that guide interactions among learners and instructors, as well as the creativity, the level of collaboration, respect, and inclusivity that is fostered within the learning space. (Jung et al., 2018)

A favorable culture and energy translate into the behavior of people who appear involved, focused, and engaged in the learning processes and dynamics.

4 Conclusions and future research

In the current scenario, learning spaces are acquiring growing importance. (Alstete and Beutell, 2018) The literature suggests that learning spaces are places where knowledge is created, shared, and applied; they may be described as spaces of interaction between individuals, their behaviors, and the external environment. Recently, public and private organizations have experimented more advanced technological tools in learning spaces, such as virtual reality, augmented reality, artificial intelligence and metaverse. Understanding how to implement digital tools in learning processes and to support the dynamics of knowledge exchange and transformation is crucial to exploit their potential and maximise their added value. In order to use the different tools effectively and consistently with the learning objectives, it is important to understand the enabling and hindering factors that can maximise their usefulness or act as barriers.

Given the new emphasis on the relevance of these kind of spaces, how to manage them, assess their performances and effectiveness has become a key topic that is gaining growing attention. (Karam et al., 2021; Krishnamurthy, 2020; Grigol et al., 2014).

In such a prospect, based on a systematic review of literature, this study provides a clear and holistic understanding of infrastructural dimensions characterizing a learning space, to support management and assessment of these spaces in educational and organizational contexts.

In consequence, the systematic literature review has provided a consistent background for the development of a theoretical framework.

Learning spaces are characterized by;

1. physical setting;
2. technological dimension;
3. organizational resources;
4. ctors and interactions;
5. culture and atmosphere.

The components of each dimension are pointed out in fig. 2.

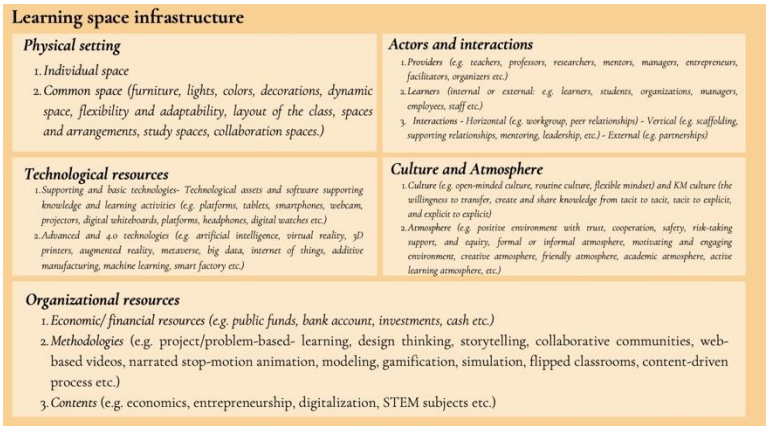

Fig. 2 – Conceptual framework representing a learning space

The research results synthesize data and knowledge gathered from the literature review and offer implications and insights both for theory and practice. From a theoretical viewpoint, the paper contributes to the further development of the literature about LS, providing a definition suitable to different levels of application. Moreover, given the growing attention on LS, the study identifies specific variables and dimensions to consider to support innovation dynamics within a public or private organization.

In conclusion, considering future research avenues, it may be useful to develop a matrix that highlights the added value that technologies (especially the most advanced ones) can bring to learning processes, highlighting which are the most

suitable, which factors enable or hinder their use and which are the most effective strategies and methodologies for their implementation. Moreover, the research highlights the importance of developing measurable key performance indicators to integrate within the theoretical framework to assess and manage LS performance effectively.

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Quantum Computing Impacts and Technological Integration Improving Business Process Modelling and Production Protocols in Industry 5.0 Scenarios

Alessandro Massaro*

Lum University "Giuseppe Degennaro"- Lum Enterprise s.r.l.
Strada Statale 100 km 18, 70010 Casamassima BA

Giovanni Schiuma

Lum University "Giuseppe Degennaro"
Strada Statale 100 km 18, 70010 Casamassima BA

Francesco Santarsiero

Lum University "Giuseppe Degennaro"
Strada Statale 100 km 18, 70010 Casamassima BA

* *Corresponding author*

Abstract

The paper discusses the impacts of Quantum Computer (QC) technology in Industry 5.0 scenarios by focusing attention on application fields such as production management in manufacturing and business modelling. The analysed literature allows for comprehending possible QC implementations and integration in technological architectures. Specifically, the work highlights QC impacts on organization, production and marketing and defines QC perspectives, advantages and possible limitations. The study also addressed the design of workflow modelling production protocols in Industry 5.0 environments implementing QC processes.

The analysis of the impacts, together with the technological aspects and the QC process management, are the main topics of the proposed paper. The paper is structured as follows. In section 1, an outline of the main QC applications and potential impacts is provided. Section 2 proposes a framework to explain the role of QC in the technological integration of Industry 5.0 production systems. Section 3 introduces a Business Process Modelling and Notation (BPMN) workflow embedding QC processes and oriented on standardising industrial production protocols. Finally, the conclusion summarizes QC advantages, perspectives and limits matching with the performed analysis.

Keywords – Quantum Computing, Business Models, Industry 5.0, BPMN

Paper type – Academic Research Paper

1 Introduction

Quantum Computer (QC) technology is a challenge to optimise the passage from Industry 4.0 to Industry 5.0 industrial production systems and, in general, to improve company business performance and update business intelligence models. Specifically, different advantages are involved in the QC digital transformation of production platforms, such as the increase of the economic value, the formulation of innovative solutions improving the competitive advantages, the speedups of business problems, the finding of optimal trading trajectories, the optimization of the machine fault monitoring (predictive maintenance), and the improvement of cybersecurity (Bova et al., 2023). QC plays an important role also in the complete control of production in advanced manufacturing Industry 5.0 production systems (Massaro, 2023): QC is proper to support and optimise Artificial Intelligence (AI) calculus by processing comprehensive data volume and to interface other advanced technologies such big data and AI edge computing systems. The use of QC technology implies different impacts of different typologies, such as:

- **organizational impact:** the use of a high-speed technology (low informatics computational cost) providing new results implies a new production velocity, flexible management of human resources (HR), a new approach to analyse the change management, and a dynamic business strategy, thus requiring a fast change of organizational management processes;
- **production management impact:** the improvement of production monitoring and the predictive maintenance through the QC calculus (the fundamental unit of QC is the Qubit associating the information on the Bloch sphere (Nielsen et al., 2004)) implies optimization of the production by formulating new quality assessment procedures and production Key Performance Indicators (KPIs); production impact is in all the supply chain sectors including logistics and raw materials management; another aspect related to production impact is the integration of the QC technologies into the information infrastructure of the company;
- **business impact:** QC enables new business models opened to a new concept of strategic marketing and new dynamic marketing trajectories, thus defining innovative and advanced business

intelligence analyses processing a large number of variables in the field of customer care, financial, micro-economic and macro-economic sectors; the business impact involves a new approach to analyse the company risks.

The analysis of the impacts, together with the technological aspects and the QC process management, are the main topics of the proposed paper. The paper is structured as follows. In section 1, an outline of the main QC applications and potential impacts is provided. Section 2 proposes a framework to explain the role of QC in the technological integration of Industry 5.0 production systems. Section 3 introduces a Business Process Modelling and Notation (BPMN) workflow embedding QC processes and oriented on standardising industrial production protocols. Finally, the conclusion summarizes QC advantages, perspectives and limits matching with the performed analysis.

2 QC Topics Matching with Industry 5.0 Applications and Impacts

QC applications are in different industrial fields. Below are some case studies and research topics in the literature that define possible QC impacts and implications in Industry 5.0 environments.

- **Data-driven in production systems** (Massaro, 2023): an advanced QC data-driven engine implies a reskill and an upskilling of HR mainly in QC programming, a new methodology of machine parameter reconfiguration, and the optimization of Machine Learning (ML) model hyper-parameters for hybrid QC/ML approaches of data analytics (Lentzas et al., 2019).
- **Energetic improvements**: smart factories are based on energy optimization also integrating renewable energy sources and interconnecting the production plants with smart grids (Ahn et al., 2022; Giani, 2021); possible impacts in production are in the energy optimization requiring digital twin decision-making engines based on prediction (Sleiti et al., 2022) and new intelligent processes managing energetic consumption.
- **Predictive maintenance**: new maintenance procedures are correlated to new production and organizational models managing maintenance, thus ensuring complete continuity of production, avoiding machine failures, product defects, and improving the product quality

assessment method (Bova et al., 2021; Bova et al., 2023); impacts are mainly in the reengineering of the maintenance processes to decrease machine costs.

- **Life cycle:** the software life cycle analysis (Weder et al., 2020) and quantum technologies (Van Erp et al., 2022) certainly require new organizational models of HR and new processes oriented on the adaption of policies in sustainability.
- **Logistics and transport** (Hamdy *et al.*, 2022; Hernández et al., 2022): applying QC in logistics requires new organizational models managing optimized logistics fluxes and just-in-time services: a capillary logistics network requires complex models simulating and predicting transport fluxes (high organizational impact managing logistics).
- **Customer care and marketing** (Ukpabi et al., 2022): QC introduces new business models which need new skills, such as advanced customer care data analysts and data scientists having the goal to update customer care strategies; inclusion of customer management in a QC framework also involves other different areas such as business and finance, manufacturing and renewable energy.
- **Cybersecurity** (Raheman, 2022): advances in QC cybersecurity require new data security professional skills based on the knowledge of innovative QC security systems (high impact in specific QC knowledge focused on cybersecurity); the goal in cybersecurity is the adoption of Zero-Vulnerability Computing (ZVC) secures computers, especially for companies offering cloud web services (secure cloud frameworks managing services).
- **Data processing performances** (Huang et al., 2021): the matching between QC and ML approaches necessitates new developers skilled in data processing and data testing; the learning of HR is mainly in using suitable testing platforms and scalable frameworks linked to big data systems.
- **Risk Assessment and Risk Management** (Wilkens et al., 2023; Woerner et al., 2019): the QC adoption introduces new organizational procedures for selecting data to process for risk assessment and risk management; this enables new openings in data analysis about financial risk measurement and risk management (high impact concerning financial risk assessment in capital investment transactions);

QC could provide new algorithms processing *hidden production information* (typically unstructured data, collected in local databases and not processed, also named as '*dark data*' (Banafa, 2022)) thus optimizing the risk analysis.

3 QC Technological Integration in Industry 5.0 Production Systems

Integrating QC technology into the company information system is essential concerning production management impact. QC technologies should be integrated into industrial platforms made by hardware and software facilities. Fig. 1 illustrates an architecture scheme of a possible QC integration with other technologies by distinguishing software, hardware, cloud and external energy sources. The framework of Fig.1 is supposed for manufacturing industries implementing a scalable Industry 5.0 approach. QC software is executed in parallel to ML algorithms supporting ML hyper-parameter optimisation. The ML algorithms are traditionally executed by standard Central Processing Units (CPU) but could be embedded in scripts of QC software, thus decreasing their computational cost. The data to process could be collected into local servers or in cloud big data systems (a synchronised data migration process could optimise the data volume locally available). The local server is typically installed inside the indoor company layout. As for manufacturing industries, data are detected in the production fields through Internet of Things (IoT) technologies and digital production machines or robots which could be powered by renewable energy sources optimizing electrical power consumption. Cloud access security could be guaranteed by adopting a QC internet access control (improvements in cybersecurity approaches).

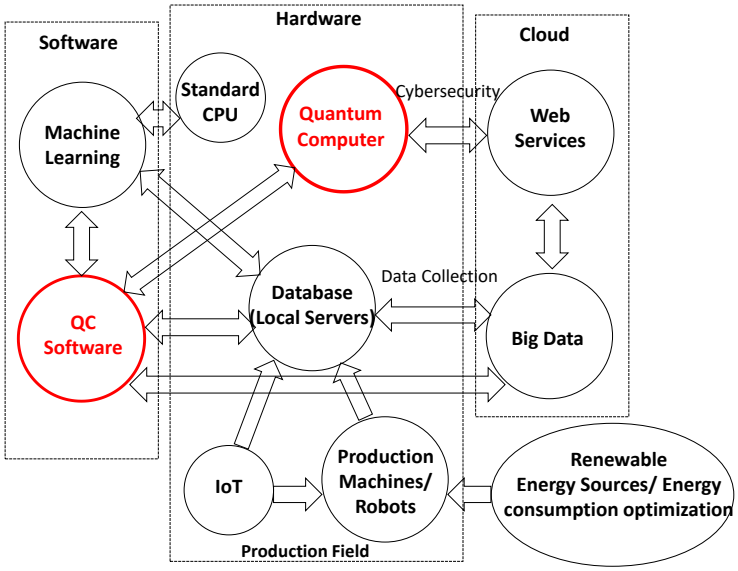

Figure 1. Architecture describing QC integration in a supposed Industry 5.0 technological framework suitable for manufacturing industries.

3 BPMN Approach and Standardization of Industrial Production Protocols

An approach to designing new processes integrating QC decision-making is the BPMN model. This section is designed as a workflow representing the main processes involved in manufacturing systems using QC facilities. In particular, the workflow of Fig. 2 illustrates an example of an operation model executing the main processes enabled by QC, such as business intelligence, predictive maintenance and HR management processes (see red boxes). The BPMN workflow represents an example of an Industry production protocol. We observe that in Industry 5.0 scenarios, decision-making of processes are improved by AI engines as for Process Mining (PM) models automatizing production control and actuation (Massaro, 2022). Following this aspect, in the proposed BPMN workflow, the AI engine is considered to strengthen the predictive maintenance and the business analytics matching with QC data processing. According to the workflow of Fig. 2, the manufacturing production process starts enabling simultaneously the three QC processes (QC Predictive Maintenance, QC Business Intelligence, QC Human Resource Management) controlled by three checkpoints (modelled by the '*Exclusive Event based*' gateway indicating the decision making logics and

highlighted in yellow in Fig. 2). The logic functions of the checkpoints are the following:

- if the production check provides a positive rank, then the production continues simultaneously with the production monitoring process, otherwise are activated specific maintenance interventions are updating the predictive maintenance plan;
- if the HR management is efficient, then the production and the monitoring process continue, otherwise, the HR organization is changed by applying new procedures managing HR (different HR allocations, activation of training plans, new employee hires, etc.);
- suppose the application of the business model provides good results (revenue increase, new customers, etc.). In that case, the production is *in line* with the company's marketing strategy (the production remains the same), otherwise are performed some production adjustments (are the production of other products or other accessories requested by the market, increase of production volume of strategic products, switching of production according to the requirements of the dynamic market, etc.).

The execution of the QC processes will induce to formulation new Knowledge Management (KM) (Schiuma et al. 2008; Schiuma et al. 2015) models (formulation of new knowledge assets) based on a new concept of change management.

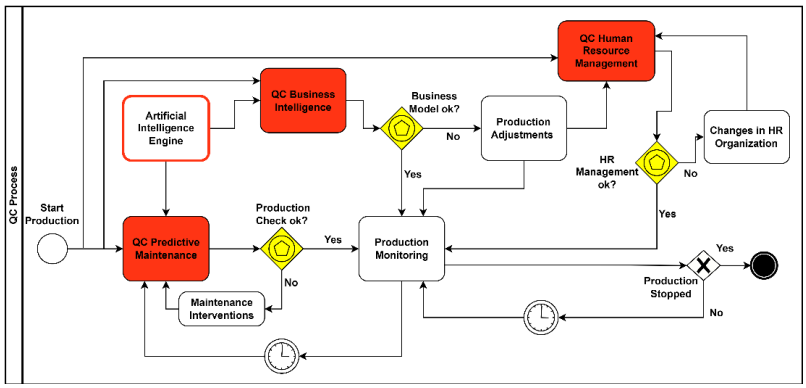

Figure 2. Example of a production Industry 5.0 protocol integrating QC decision making: BPMN workflow integrating QC operations.

4 Conclusions

The introduction of QC in the actual industrial scenario enables different changes in technological integrations and the management of resources generating different impacts because the QC behaves as a 'reactor' accelerating production and activating advanced business models and data processing. This has a high impact mainly on organizational, production and business processes. The QC outputs could differ from traditional analytics algorithms, including AI calculus. Furthermore, QC offers a great capacity to process more information and hidden data quickly, even present on the web, thus optimizing risk analysis and data processing. The proposed paper aims to define QC application fields matching with impact analysis and technological integration in advanced manufacturing industrial platforms suitable for Industry 5.0 frameworks where the integrated QC technologies are considered part of an Industry 5.0 production framework. Furthermore, the work discusses a BPMN model that addressed integrating QC processes into a standard production workflow simulating an advanced Industry 5.0 production protocol. The performed analysis enhances that the QC facilities offer different advantages such as:

- an economic advantage in formulating innovative business intelligence models;
- an expansion of production layouts optimizing monitoring processes;
- the increase in product quality;
- the optimization of customer services and customer care models;
- the optimization of logistics and transport fluxes;
- the running of a calculation thousands of times faster if compared with the traditional calculus in data analytics (traditional algorithms, including AI ones);
- a solution to complex problems characterised by a large number of variables;
- the optimization of the prediction of production fault conditions;
- the definition of new sustainability criteria about production perspectives;
- the formulation of new KPIs based on a complex calculus;
- an improvement of the risk assessment predicting financial scenarios;
- the simulations of complex systems (including networks, marketing trajectories and chemical structures);

- the optimization of ML models (optimization of the hyper-parameters);
- the optimization of energetic consumption and energetic management;
- the introduction of novel approaches to strengthen cybersecurity.

QC perspectives are mainly in integrating technologies by adopting flexible information infrastructures and cloud big data systems supporting QC calculus. Furthermore, QC will define new change management and KM models based on a new concept to process information (re-design of all supply chain processes integrating QC decision-making and QC knowledge): new processes defining the production protocols and procedures will be designed taking into account new decision-making logics based on QC outputs gaining the knowledge. Concerning limitations, an initial bottleneck is the specific learning of the future informatics developers, which should be upskilled '*with precision*' in developing ML/QC algorithms. Another limitation is the still high cost of QC technologies, even if the market is already moving towards cost reduction by proposing standalone solutions.

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Inspiring and Leading Innovation, Digital Transformation and Entrepreneurial Dynamics in Cultural Industries: State-of-the-Art and a Future Research Agenda

Antonio Lerro*, Francesco Santarsiero

Department of Mathematics, Computer Sciences and Economics
University of Basilicata
Viale dell'Ateneo Lucano, 85100 Potenza (Italy)

Daniela Carlucci, Rosaria Lagrutta

Department of European and Mediterranean Cultures
University of Basilicata
Via Lanera 20, 75100 Matera (Italy)

Giovanni Schiuma

Department of Management, Finance and Technology
LUM University "G. De Gennaro"
SS 100 Km 18, 70010 Casamassima (BA) (Italy)

* *Corresponding author*

Abstract

The main objective of this research article is s to briefly present the current state-of-the-art about the emerging innovation and entrepreneurial dynamics and the impact of the digital transformation in the Creative and Cultural Industries (CCIs) and to delineate potential future research directions.
The paper combines a deductive and an inductive approach.
The research outlines the needs to addressing in a more specific way the dimensions of innovation, the role played by digital transformation and the potential paths of entrepreneurship in CCIs.
The value of the article mainly resides in its attempt to identifying and clarifying relevant themes and unanswered research questions about innovation and entrepreneurial dynamics in CCIs to be effectively declined and investigated according to an inter-disciplinary perspective.

Paper Type – Academic research paper

1 Introduction and overview

In the recent years the notion of Digital Transformation (DT) has largely emerged in the scientific and business debate. Accordingly, various scholars have analysed its impact on different managerial variables, such as work organisation, products and services, supply chains, levers of marketing and sales, business models (Boulton, 2018; Berger et al., 2019; Cennamo et al., 2020; Porter and Heppelmann, 2014, 2015; Raff et al., 2020; Svahn et al., 2017).

In this vein, Appio et al. (2021) and Hanelt et al. (2020) provide effective reviews, highlighting the relationships between DT and traditional industries (Iansiti and Lakhani, 2019; Venkatraman, 2017), the role of the DT for the creation of new multisided platforms and knowledge ecosystems (Cozzolino et al., 2018; Elia et al., 2021; Fraser and Ansari, 2020; Nambisan and Baron, 2019; Parker et al., 2017), on the change that DT brings to the innovation processes (Lu and Ramamurthy, 2011; Ransbotham et al., 2016; Reibenspiess et al., 2020; Sedera et al., 2016). Despite the great resonance of the themes and the connections with DT, managerial literature highlights at least three significant limitations. The first one refers to theoretical issues and, in particular, the failure to incorporate comprehensive approaches beyond the information systems streams and to adopt a more interdisciplinary view of management fields (Appio et al., 2020; Nambisan, 2019; Nambisan, 2017; Kallinikos et al., 2013; Yoo et al., 2010).

The second limitation is related to the limited attention to the antecedents of the digital transformation (Broekhuizen et al., 2021; Hanelt et al., 2020; Vial, 2019) as well as to the enablers of the digital transformation at the organisational level (Appio et al., 2021).

The last limitation is rooted in the great focus paid by theory and practices on applications and impact of DT in large companies and traditional manufacturing industries while limited studies have paid attention in a rigorous way to the wide world of the Creative and Cultural Industries (CCIs).

This is rather surprising since it appears as not aligned with the great emphasis and attention that both academia and local, national and international policies have recently provided about these industries. In order to fill these gaps, this paper aims to stimulate a debate about why and how inspiring and leading innovation, DT and entrepreneurial dynamics in CCIs. For these motivations, a research agenda is proposed by focusing on three broad themes related to

entrepreneurial development and digital transformation in CCIs by positioning them around three different levels of analysis, i.e. macro, meso and micro.

Our hope is that the identification and the discussion of a set of open issues may address future research efforts in order to decline and inform entrepreneurial development and DT practices in CCIs more coherently and effectively.

2 Innovation, digital transformation and entrepreneurial dynamics in cultural industries: where do we stay? Perspectives of analysis

A set of issues capable to play a grounding role for a new research agenda aimed to dentifying and analysing the emerging trends, opportunities, and challenges related to the innovation, the entrepreneurial development and the digital transformation in CCIs has been elaborated. Of course, these themes are not the only ones relevant in the context of analysis. Moreover, our aim is not to provide an exhaustive analysis or commentary on these issues. Still, we hope to highlight the relevance of developing a research agenda built on common themes characterising CCIs. After a brief introduction and definition of CCIs, the research issues are presented and discussed.

2.1 Cultural and Creative Industries (CCIs): introduction and definition

CCIs are extensively defined as "those industries which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property" (DCMS UK 2001, p. 4) as well as producing "experience goods with considerable creative elements and aim these at the consumer market via mass distribution" (Peltoniemi, 2015, p.41).

As highlighted by different researches (Landoni et al., 2020; Coblence and Sabatier, 2014; Eikhof and Haunschild, 2007), it is possible to link the growing interest in management studies on CCIS to different aspects, such as their idiosyncratic characteristics, the nature of traded goods and the existence of tensions between artistic orientation and financial balances (Foss and Saebi, 2018; Durand and Jourdan, 2012), extremely unpredictable demand (Caves, 2000), the chronic resource constraints and growth issues, a very articulated value chain (De Bruin, 2007; Henry, 2007), the capabilities and experience of entrepreneurs

(Sundbo, 2011), the particularity of their business modelling (Schiuma and Lerro, 2017).

In this vein, attention on CCIs is furtherly increased in the last years due to the new challenge of change instilled by the current DT. In fact, as discussed by Landoni et al. (2020), the wide toolkit to be referred to digital technologies is fostering innovation opportunities in CCIs (Iansiti and Lakhani, 2014), reducing the time needed to create and launch new products and solutions (Marion et al., 2015), and facilitating pervasive change in business models (Feng Li, 2018; Nambisan, 2017). However, dynamics and effects still need to be effectively and rigously identified and declined to be extensively generalized, also considering pre-conditions, enabling and hampering factors, territorial contexts, real insights deriving by the empirical evidences.

2.2 The macro-level: the scenario analysis

At the macro-level, the focus is on the scenario analysis and the challenges determined by COVID-19. On the commission of the Wallace Foundation (2020a, b), AEA Consulting recently attempts to delineate possible avenues for the CCIs, highlighting emerging opportunities and challenges across areas such as organisational planning, programming, income generation, audience engagement, workforce and leadership development, physical infrastructure and lobbying and collaboration. In this vein, particular attention is paid to *i)* the increased digital engagement, in terms of proliferation of new creators and platforms focused on digital production and consumption and development of new business models and regulatory frameworks specialised for the digital sphere and to *ii)* the decreased government and/or philanthropic support determining a need for innovation in earned income generation digital-enabled as well as the development of channels to support artists and creators directly.

2.3 The meso-level: new forms of collaboration

At the meso level, the focus is on how CCIs may revise and structure their products, services, processes, also in response to DT. In this sense, characteristics such as new modes of collaboration and integration with traditional businesses and review of the internal and external organisational boundaries represent

significant emerging building blocks on how creative and cultural organisations may restructure their dynamic capabilities to embrace DT.

New emerging streams of academic research argue that creativity, design, culture, arts and, more generally, the cross-fertilisation of ideas are increasingly needed in business, science and technology as well as their spread through and across all the above systems and contexts (Adler, 2006; 2010a, b; 2011; Andersen *et al.,* 2011; Darsø, 2004, Hall and Johnson, 2009; Lerro *et al.,* 2016; Savino *et al.,* 2017a).

In this view, Schiuma (2011) and Schiuma and Lerro (2017, eds.) show more systematically how arts and creativity-based assets and processes have been increasingly recognised as potential catalysts and levers to support organisational change management programmes, to inspire new entrepreneurial behaviours, frame new business models, improve practices and stimulate the innovation capacity of the whole organisation.

Evidence-based on SME and extensive company activities (e.g., Stuart and Podolny, 1996; Benner and Tushman, 2002; Siggelkow and Levinthal, 2003; Messeni Petruzzelli and Savino, 2014; 2015) shows that innovativeness and entrepreneurial dynamism can be enhanced when industry and technology domains are open to a broader range of influences, including interfaces and learning from other types of industry and organisational systems (Santarsiero *et al.,* 2021; Savino *et al.,* 2017b).

There are indirect and direct impacts on management and working practices virtual and internal team processes, leading eventually to improvements in new added-value products and services. With this perspective, organisations and firms operating in the CCIs can act as key partners. Indeed, they can inspire and support entrepreneurs and managers to innovate high-tech products and services, frame new organisational processes and business models, reconsider human resources, and draw on new approaches and instruments to tackle emergent business challenges (Pratt and Jeffcutt, 2009; Cannarella and Piccioni, 2011; Paltoniemi, 2015; Schiuma, 2011; Schiuma and Lerro, 2017).

In this vein, also training and education spheres are revisiting their models, trying to define a future of common projects between technique and history, archaeological culture and science, humanities and advanced scientific research on new materials, in particular, addressed to museums and heritage and cultural domain.

2.4 The micro-level: Digital transformation and business model innovation

At the micro-level, attention is paid to how DT may impact business model innovation and, consequently, entrepreneurial dynamics. Digital technologies and related tools are transforming the CCIs and fostering the emergence of new entrepreneurial models as well as business models (Al-Debei and Avison, 2010; Gordijn and Akkermans, 2001), although research till now remains somewhat elusive and poorly understood (Spieth *et al.,* 2014, Visnjic *et al.,* 2016).

Feng Li (2017) effectively examined how digital technologies have facilitated business model innovations in the creative industries. Moreover, it also explores the potential role of the creative industries in stimulating innovation and entrepreneurship across different sectors of the economy. Landoni *et al.* (2020) have recently analysed the business modelling of three highly successful companies operating in the mobile gaming industry, highlighting how the business model innovation in CCIs follows the life-cycle of the organisations and showing reputation, new distribution paradigms, and extension of product portfolios as drivers of business model innovation.

These research considerations seem to be confirmed by real experiences elaborated and developed practically by museums and arts institutions worldwide in response to the COVID-19 pandemic. Most of them have changed both the modes through which artistic and cultural manufactured goods are generated, acquire value and are offered and, above all, the relationship with the passionate people. They have successfully developed social-based activities, virtual tours, live streaming, new educational programs, and augmented reality experiences to let the living of arts in a more immersive way. The evidence gathered in this short analysis suggest, then, the broad and different potential prospects of innovation and entrepreneurship across a range of future unknowns.

3 Innovation, digital transformation and entrepreneurial dynamics in cultural industries: what's next?

The analysis briefly developed tries to shed new light on different phenomena regarding CCIs, entrepreneurial development and digital transformation and their intersections. Research highlights a missing unified perspective and a general framework capable of summarising theoretical and empirical efforts.

Accordingly, much remains to be done in future research. Firstly, at the macro-level, more research is needed to define the institutional, economic, and social conditions that can stimulate and enhance entrepreneurial development within the CCIs. This is also related to better framing the specific characteristics and peculiarities of the jeopardised world of the CCIs, above all at the light of the "new normality" determined by the COVID-9 pandemic. Second, at the meso-level, the collaboration with traditional business and the relationships with social and public players play a fundamental role to be addressed in the future research .Third, given the increasing adoption of new business models, new research is needed to deeply analyse and quantitatively assess whether the renewed modelling supports organisations' financial sustainability, innovation processes, value and quality of products and services and stakeholders orientations and discover new business models yet not fully emerged. It is obvious that our highlights are just a small part of the potential research to be addressed, taking into account that the speed of change of the digital technologies let analysis, debates and effects really unpredictable in the medium and in long term.

4 Innovation, digital transformation and entrepreneurial dynamics in cultural industries: first empirical evidences in Basilicata region

In order to support and enrich the theoretical framework, an exploratory empirical research has been designed and partially implemented to collect direct insights and drow managerial and policy implications regarding the cuurent state of the creative and cultural organizations based in the Basilicata region, in the South Italy. The first empirical evidences – collected referring to a sample of museums - show that their innovation processes and initiatives of digital transformation are not still generating real benefits and opportunities for the economic and social growth as well as a new and a better employment for a territory like Basilicata.

It is possible to state that in Basilicata there are examples of various projects aimed to apply DT tools in museums and historical parks: for example the videogames *Invention,* created for the Archaeological Park of Venosa, and *Hold the Hut,* promoted by the project "Tutela e Valorizzazione dei resti di un'antica capanna" and the temporary exhibition "Tiresia il mito nelle tue mani" created by the National Archaeological Museum of Matera. Despite these experiences, the projects appear spot, not easy to scaling-up in their application and limited at

territorial levels. These concerns seem to be integrated with other limitations such as the lack of managerial, technological and digital skills; or to the lack of pre-conditions not allowing the normal use of cultural heritage according to a modern and technology and digital-driven perspective.

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Lights and Shadows of Sustainability in Healthcare: A Literature Review

Federica Asperti*

LIUC – Carlo Cattaneo University
21053 Corso Matteotti 22, Castellanza (Italy)

Emanuela Foglia

LIUC – Carlo Cattaneo University
21053 Corso Matteotti 22, Castellanza (Italy)

Elisabetta Garagiola

LIUC – Carlo Cattaneo University
21053 Corso Matteotti 22, Castellanza (Italy)

Lorella Cannavacciuolo

Dept Industrial Engineering –University of Naples Federico II
80125 P.le V. Tecchio 80, Naples (Italy)

Eleonora Gheduzzi

Dept of Management Engineering – Politecnico di Milano
20156 Via Lambruschini 4/b, Milano (Italy)

Stefania Manetti

Dept of Management Engineering – Politecnico di Milano
20156 Via Lambruschini 4/b, Milano (Italy)

** Corresponding author*

Abstract

Sustainability is becoming a crucial research area, not only considering industrial contexts, but also managing healthcare, environmental, and social issues, adopting a holistic, multidimensional, and multi-stakeholders' approach.
In a world where economic growth has been the primary objective in all the industries, the need to integrate environmental and social sustainability into business strategies first and then into daily activities is strongly emerging.

Sustainability could be declined in three main pillars: economic, social, and environmental, traditionally in all the industrial and organizational settings, but this could generate peculiar instances also in the healthcare field.
Being sustainable is becoming an urgent priority for the development of worldwide population. This unmet need should be addressed in any settings of the healthcare context, considering macro (i.e., healthcare system), meso (i.e., hospital) and micro (i.e., process) levels. Healthcare services are necessary for sustaining and improving human well-being, but the environmental impacts and the carbon footprint generated by these services, contributing to environment-related threats, are high.
Assuming the One Health approach (Atlas, 2013) and referring to the health, environmental and social dimensions as closely interconnected, the importance of investigating the link between technology and sustainability emerges.
To achieve this goal, a systematic literature review was conducted, including 86 articles that were divided into three different clusters considering papers devoted to technological aspects, models, assessment frameworks' development, and telemedicine. An analysis of the research areas interested was performed considering a double perspective, assessing environmental and social issues.
From the literature evidence, a strong relevance of technologies as the principal driver to guide the sustainable transition and an impulse to define quantitative indicators and assessment tools, emerged, also considering the necessity to support the decision-making process and the stakeholders' knowledge, to guarantee a green and sustainable development of healthcare systems.
The results included in the review demonstrate a significant diffusion of performance measurement models and systems, especially in relation to the environmental aspects, also considering innovative processes and technologies. The analysis of the social aspects is still limited, particularly in relation to the corporate social responsibility topic.
Therefore, this contribution would highlight the need to define multidimensional assessment models, integrating the different pillars of sustainability, also into the technological governance process.

Keywords – Sustainability, Healthcare, Technology, Model, Environment

Paper type – Academic Research Paper

1 Introduction

Sustainability is a broad and umbrella term, representing a debated topic and a priority for the sustainable development of worldwide population (Sachs, 2012).

The concept of sustainability has been defined and applied differently (Walugembe et al., 2019) in generating evidence under different perspectives of analysis. Traditionally, sustainability could be framed into three different dimensions: economic, social and environmental (Purvis, 2019). Pursuing these

three pillars helps healthcare facilities not only to improve health outcomes for patients, but also to enhance the attention to natural environment, supporting healthy communities with equal access to care, and guaranteeing the achievement of economic sustainability.

There is a growing interest in understanding how to shift toward economically, socially, and environmentally viable healthcare systems (European Commission, 2016; Chiarini & Vagnoni, 2016), that are ones of the major emitters of pollutants (Eckelman & Sherman, 2018).

However, healthcare sustainability is still presented as a multifaceted theme that also embrace social and environmental dimensions with the economic one. **Social sustainability**, which relates to the hospital's role in promoting sustainable development and providing healthcare facilities able to guarantee equal access to healthcare services, high-quality of care, and equitable distribution of healthcare resources among patients, also considering specific categories of patients, peculiar diseases and disadvantaged geographical conditions (Kamranfar et al., 2022).

This aspect also encompasses the hospital's impact on the community it serves, and the well-being of the patients taken in charge and the working staff.

Environmental sustainability is a significant contributor to environmental degradation: thus, sustainable practices, in this context, must be developed to minimize the carbon footprint, addressing issues, such as the climate change (Scherman et al., 2020). Hospitals, and healthcare organizations in general, could prioritise investments in energy-efficient technologies, implementing waste management programmes and recycling policies, to address these concerns. Additionally, sustainable healthcare approaches could positively impact public health strategies, making healthcare services more accessible and improving overall healthcare quality. Effective leadership and health policies are crucial, for achieving sustainable healthcare systems, also promoting the adoption of telemedicine and telehealth solutions.

Moving on from these premises, the present review aims at investigating how social and environmental sustainability is assessed in the healthcare context and if frameworks and/or models could be applied to healthcare sustainable processes and practices. According to the One Health approach (Atlas, 2013), a paradigm of action and analysis in which health, environment and social aspects are strictly interconnected, is necessary for future implementations.

A holistic perspective integrating social and environmental dimensions is underway (Pereno & Eriksson, 2020) and for this reason the research focused on these dimensions.

The final goal is to provide both practical and theoretical contributions. In practical terms, this paper aims at encouraging healthcare organizations and policy makers to develop more sustainable healthcare systems and services (by providing empirical evidence for its implementation and assessment) able to keep in account both dimensions. At theoretical level, this study clarifies the boundaries of the concept of sustainability in the healthcare sector and opens avenues for future research.

In pursuing this aim, this paper focuses also on the use of innovative technologies for improving social or environmental sustainability in healthcare. In 2017, OECD highlighted the importance of new technologies in pursuing the economic sustainability in healthcare sector (OECD, 2017). However, innovative technologies could have a crucial role also in pursuing the social and environmental sustainability. This is relevant since the concepts of "digital" and "innovation" are emerging as more and more pervasive, in the healthcare world (Basri et al., 2021). Digital and innovative technologies are the main enabler in controlling the carbon footprint and reducing the pollutants emissions (Linkov et al., 2018), as well as in achieving the United Nation's Sustainability Development Goals (SDGs) (Asi&Williams, 2017). When a technological solution is affordable and accessible, its ability could be detailed in terms of increasing the systems' productivity and efficiency, in an industrial context, but also in the healthcare sector, identifying reductions in emissions and waste. Furthermore, digital technologies such as big data, artificial intelligence (AI) and cloud computing could be used to support the production and delivery of essentials such as safe and reliable energy, food, infrastructure, and transportation, also for healthcare organizations.

The research questions that were identified to achieve the outlined objectives are as follows.

> *RQ1) Which are the fields of application within the healthcare context in which the environmental and social sustainability has been assessed so far?*
> *RQ2) What are the methodology/models/frameworks that have been used to assess environmental and social sustainability within the healthcare setting?*

RQ3) Which technologies play a key role in sustaining environmental and social sustainability?
RQ4) In which settings do these technologies have applications to drive the process of sustainable transformation?

2 Methodology

To answer the research questions, a literature review approach was implemented to define a critical evaluation and synthesis of state-of-art and current studies (Webster & Watson, 2002).

Focusing on healthcare sustainability and its environmental and social impact, also including the technological development and the possibility to assess all the impacts in a multidimensional perspective, helps to identify gaps in knowledge and research, evaluating current practices, and inform policy decision-making processes. Additionally, this methodological approach could also provide insights into the effectiveness of existing healthcare sustainability programs and initiatives, supporting the decision-making process with high-level implications also for the healthcare managers and for all the stakeholders.

For the achievement of the above-mentioned objectives, a structured literature review (Denyer et al., 2009) was conducted, using three different data sources: PubMed, Scopus and ABI Inform.

Starting with the literature review, following the principles of transparency (Matalonga et al., 2020) and defining a synthesis that could be considered replicable and updatable, the search strategy included all the combinations of the following keywords: "Healthcare", "Sustainab*", "Environment", "Social", "Impact" and the results containing the reference to economic topics were not considered. Economic factors are undoubtedly important in the context of healthcare sustainability, but for the purposes of this literature review, the focus of analysis has been placed exclusively on environmental and social sustainability, basing the decision on several factors. This focus is decided also following the One Health approach, which states the necessity to define and monitor social and environmental aspects in relation to the health issue, as two factors that could impact in a positive or negative way on the patient's health status.

In addition, due to the specific nature of RQs, there was a significant body of literature already published and discussed over the years on the economic aspects of healthcare sustainability, only discussing this dimension of interest.

This great attention is due to the healthcare field necessity to develop new solutions and public policies, re-engineering processes and finding new approaches, having as principal objective to properly manage severe economic constraints and correctly handle with the scarcity of resources.

Moving from these premises, the aim of the present research is to provide a different perspective by focusing on less discussed other dimensions, which equally play a relevant role, balancing the resources' consumption topic, guaranteeing the health and care needs of individuals and populations, also safeguarding the natural and environmental landscape.

As stated in the introduction section, "digital" and "innovation" are considered as two important drivers for the sustainable transition within the healthcare sector. They are not strictly included in the search strategy as keywords, considering that often, focusing on technological aspects, innovative and digital components are crucial for the topic discussed, but not explicitly mentioned in the paper.

During the review process, only the papers published after 2010 were considered, also including in the screening only the following types of documents, as a selection criterion: articles published in international journals, conference papers, conference proceedings, and reviews. In addition, two different classifications (ABS and AiIG ranking) were used to assess the quality of the business and management publications. International and national classifications have been used during a literature review to confirm the valuable source of the scientific evidence gathered during the review process, providing important insights about quality, reputation and academic institutions and research outputs' impact. ABS ranking, an international rating defined in the management field to evaluate the quality of the scientific publications, and the AiIG ranking, defined by the Italian Industrial Engineering Association, were applied to assess the quality of the evidence, according to the quality level recognised and accepted in this research field.

However, the rankings were not used as substitutes and a critical evaluation of individual studies or sources was conducted by a panel of five experts in healthcare field (4 management engineers and 1 economist).

The screening was conducted by selecting each paper according to the research area of reference, the dimensions of sustainability declined in the study, any possible geographical scope, the methodology, as well as proposing a

classification of the papers, considering three different clusters of reference (telemedicine, technology, and models), dependent on the contents covered.

The brainstorming technique was useful to provide a definition of the inclusion criteria and a double-blind review process was performed considering that some experts read the papers chosen by the others, to confirm the inclusion of the evidence in the review.

Papers approaching topics not related to sustainability, or topics related to sustainability, but not presenting evidence on the defined possible impacts, as well as papers discussing only organizational aspects, operations, and education issues were excluded from the analysis, because considered out of scope.

3 Results

Providing a robust synthesis of the literature evidence, the guideline defined by Briner et al. (2012) was followed, as reported in the Figure 1.

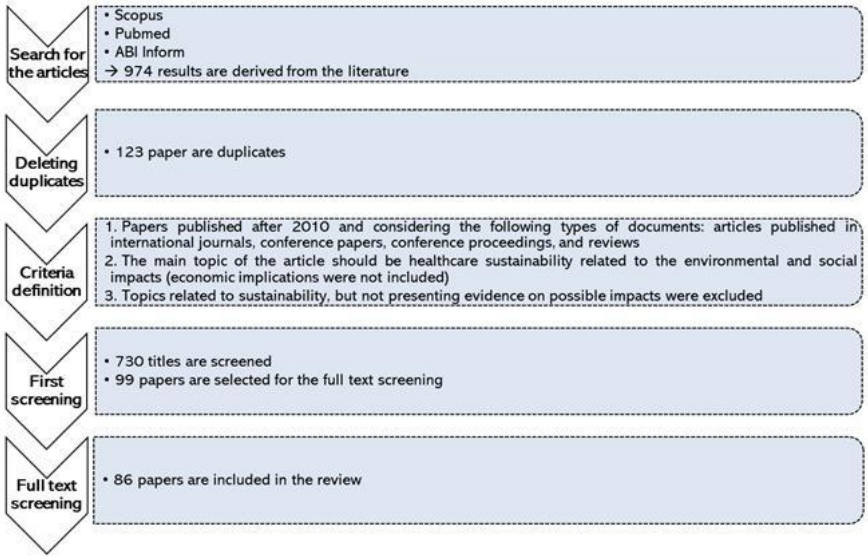

Figure 1: Literature review process

A total of 974 scientific publications were initially identified in the literature and then, after the duplications' removal, 730 papers were screened performing the screening process as detailed above. At the end, a total of 86 articles were included in the review.

Results showed that literature evidence studied sustainability in healthcare setting, analysed within different research areas related to the healthcare setting, could be described as a broad subject linked to social, environmental, and economic aspects while in other papers the topic is developed in relation to European sustainability goals (inclusion, reducing inequalities, access to essential healthcare services) proposed by the United Nations within the European program known as Agenda 2030.

Focusing only on social and environmental aspects, as stated as inclusion criterion for the review, the papers' majority results related to the environmental sustainability (51%) and only 6 papers (7%) are focused on social themes and implications. 36 papers (42%) present a double declination of the sustainability evaluating both the environmental and social impacts, combining two points of view within the declination and description of the topic.

From the results, emerged the interdisciplinary nature of the studies that also revealed the necessity to monitor and assess economic implications. In 44 papers (51,2%) the economic theme, as a declination of the sustainability concept, is presented. More studied reported indicators in the model, considering the economic sustainability as one of the dimensions within the complete model, or costs analysis as the consequences of sustainable actions applied in the healthcare setting. In 42 papers, the economic dimension is not included in the analysis and results.

Table 1: Sustainability declinations in the literature

Sustainability declinations	**# Papers**	**%**
Environmental sustainability	**44**	51%
Environmental and social sustainability	**36**	42%
Social sustainability	**6**	7%
86 papers included in the review		

Considering all the declinations of sustainability, the circular economy theme is presented in the majority of the papers as the ideal model to reach and implement within the healthcare setting, also a consequence to the implementation of a new patient-centred paradigm.

Despite this, different studies provided definitions of healthcare sustainability from many perspectives and all the authors agreed to state that a green transition could be considered as a new system of behaviour, knowledge and mindset, assuming an integrated approach that also embraces the innovation field and the possibility to act a cultural change into the healthcare setting (Porter-O'Grady, 2010). The green transition is a cultural and operational change in performing daily activities and reaching the objectives and, considering this pathway, also the management rules and the business models must change (Porter-O'Grady, 2010).

The breadth of the concept is demonstrated also from the analysis of the research areas most interested with regard health sustainability studies as reported in the Table below (Table 2).

Table 2: Research areas

Research areas	# Papers	%
Waste management	16	18,6%
Smart and digital solution	10	11,6%
Performance measurement	9	10,5%
Supply chain management	9	10,5%
Building assessment	7	8,1%
Adoption of innovation	7	8,1%
Environmental Impact Assessment	5	5,8%
Technological governance	5	5,8%
Resources management	4	4,7%
Operational excellence	3	3,5%
Facility location and network design	2	2,3%
Human Research Management	2	2,3%
Social enterprise	2	2,3%
Other research areas (decision making, organizational model, publich health, quality assessment and sustainability assessment)	5	5,8%
86 papers included in the review		

Most of the papers are related to waste management, performance measurement and supply chain management. Environmental implications could be analysed considering the emissions and the pollution generated by healthcare organizations, not only conducting their operational and daily activities within their physical perimeters but also considering the entire supply chain and the possibility to create a sustainable network in which all the players are involved,

facilitating green supplies and deliveries, complying with the ISO 14000 certification, promoting eco-friendly designed healthcare products and services with also the support of green packaging of pharmaceutical and essential items (Hossain et al., 2022). The performance measurement systems or models are relevant to guide and monitor the definition of green supply chains, also considering the social implications related to their implementations (Anilkumar et al., 2022). In addition, the transition could be supported also by innovative technologies (Jin et al., 2021; Hellstrand et al., 2021), smart solutions' development (Espinosa et al., 2021; Lo Presti et al., 2019), organizational changes (Vaishnavi et al., 2022) and industrial systems (Faramondi et al., 2020; Kumar et al., 2014).

The research effort in relation to the topic of sustainability, even in very different fields, was also driven by the recent pandemic period, with the necessity to develop the vaccines supply chain and also the increase in the waste production due to a growth in the use of disposable personal equipment, revealed the key issues that healthcare organizations have to face, also considering the sustainable development (de Aguiar et al., 2021). Furthermore, the adoption of sustainable practices, related to energy efficiency, water use reduction or devices' end of life management, improves healthcare performance, which consequently could generate a positive influence on circular economy (Daù et al., 2019).

During the review process, three clusters were adopted to classify the results and to understand the main contributions found in literature search. The clustering analysis allows to divide the scientific evidence according to the focus or not on a technologies and innovative devices. In addition, we have given a specific attention to telemedicine. Against this backdrop, the classification is the following: scientific studies in which models and assessment frameworks were proposed (57 papers, 66,3%), papers related to technologies and innovative devices (26 papers, 30,2%), and, at least, articles devoted to present and discuss telemedicine programmes and solutions (3 papers, 3,5%).

Cluster 1: models/framework for assessing sustainability

Assessment frameworks and indicators should be designed according to a holistic perspective of sustainability and applied for the related evaluation (Sherman et al., 2020).

To assess sustainability, models, and frameworks were defined and applied in the literature, considering waste management (Li et al., 2021), buildings and facilities (Castro et al., 2017), such as human resources and supply chain practices, with the support of performance indicators and other tools as balance scorecard (Leksono et al., 2019). 58 papers (67%), out of the 86 papers, included in the present review, are focused on models, that are classified considering the following declinations, as reported in the Table 3.

Conceptual framework as a definition was used to categorize papers in which the expected relationship between variables, and also the impact on environmental or social sustainability within the healthcare setting, is modelled. Instead, some papers are devoted to present quantitative indicators and measures (performance measurement) and the combination of these two components allows to classify the model as a complete model. All the literature evidence in which significant variables impacting on healthcare sustainability are presented, without defining a framework, was attributed to the cluster related to the antecedents.

Table 3: A focus on the papers related to models and assessment framework

Model declinations	**#**	**%**
Conceptual framework	29	50,0%
Performance measurement	13	22,4%
Complete model (framework + performance)	9	15,5%
Literature review	5	8,6%
Antecedents	2	3,4%
58 papers		

Half of the studies are focused on conceptual frameworks even if also performance tools and complete models are structured to evaluate the sustainable development. Conceptual frameworks could be based on fuzzy logic approaches (Tseng et al., 2020; Erjaee et al., 2022; Li et al., 2021), mode and effect analyses (de Ridder et al., 2022) and life cycle assessment (Thiel et al., 2017; Nagai et al., 2021). An intense relevance is devoted to defining framework to evaluate and assess the introduction of innovative technologies that could support the sustainable transition in organizational and clinical settings, not only with a direct contribution on the emissions' decrease and a positive impact on the patients'

experience (Hellstrand et al., 2021) but also contributing to the waste reduction (Chen et al., 2021), combining three dimensions of interest.

Frameworks are developed in the literature evidence also to study and analyse the barriers occurring in the healthcare setting for the sustainable development, both on the environmental perspective (Kazançoğlu et al., 2021) and on the social one (Hussain et al., 2019).

Performance indicators, within the area of performance measurement, are developed with multiple approaches supported by structured technique useful to organize and guide complex decisions such as the ANP, Analytic Network Process (Buffoli et al., 2013; Leksono et al., 2019), and quantitative parameters are defined to assess sustainable performance in terms of operational and strategical decisions, covering also different dimensions of the sustainability, to support decision making during the design of a healthcare building (Castro et al., 2017).

Complete models are developed, also considering the human rights, assuming the patients' perspective, with the definition of a set of indicators useful to assess the quality and sustainable development in healthcare at the micro system level, involving quality, economic issue, environmental impact, social implications both at the institutional-macro and at the hospital-meso level (Moldovan et al., 2022). Social issues are investigated also due to the implementation of structured models applicable to healthcare supply chains (Khosravi et al., 2019), home-care network (Goodarzian et al., 2021) and, in a more comprehensive way, for the decision-making process (Li et al., 2020).

Cluster 2: technologies and innovative papers

In an organizational context in which the digital sphere is becoming increasingly pervasive, also technologies could be considered as enabler for the sustainable transition (Espinosa et al., 2021). For this reason, during the review process, a grouping of the results is conducting to underline and highlight the technological improvement devoted to transform the healthcare setting, in a green and sustainable one.

27 papers are related to technological aspects: technologies are presented as a possibility to transform the healthcare setting through a sustainable approach, also considering the possibility to introduce biomaterials to decrease the medical devices' environmental impact (Salvatore et al., 2020). Digital tools and Artificial Intelligence (AI) algorithms could also allow to reduce waste and the carbon footprint (Damoah et al., 2021), notably considering disposable devices and

personal protective equipment, as emerged during the COVID-19 emergency, as above mentioned.

Table 4: A focus on the technological solutions able to support the sustainable transition

Technological cluster	# Papers belonging to the cluster	Examples
Devices	9	Marine collagen, inhaler devices, wearable sensors, robotic hand, custom pack, disposable instruments
Smart solutions	10	Telecare services, AI solutions, drones, Internet of Things (IoT) systems, cloud computing systems
Equipment	4	Technologies for waste treatment, medication management automated systems
Energy equipment	3	Nanogenerators, storage technologies
Diagnostic equipment	1	Magnetic resonance imaging
Drugs	1	Drugs for rare diseases
27 papers		

Technologies are strictly related to the sustainable development, considering the environmental declination of the concept, for their nature but also evaluating the capacity to activate and support the green transition of processes and organizations (Godbole et al., 2021). IoT applications, in terms of sustainable development, represent a great opportunity to prevent diseases and pandemics worldwide, supporting drug manufacturing, logistics but also health population planning and management, with the possibility to generate high volumes of data (Espinosa et al., 2021) and to monitor patients at home (Lo Presti et al., 2019).

Meanwhile, innovative technologies are recognised as a driver for enhancing the economic sustainability, decreasing for instance costs to transfer of care, from hospitals to home-care settings, improving safety (Tsagkaris et al., 2021).

Hence, to guarantee high-quality services, and the use of adequate technologies, multidimensional and multi-professional approaches are necessary to the implementation of sustainable programmes, with integrated models: *"e-Health services can give rise to innovations that are relevant to the transition but not self-sufficient"* (Pereno & Eriksson, 2020).

However, referring to the technological implications, a significant relevance nowadays is devoted to innovative materials (i.e., as marine collagen, dental materials, degradable bacterial cellulose for oral healthcare) to support the green transition and the decrease in the waste production (Jin et al., 2021; Salvatore et al. 2020).

In addition, digital technologies could also impact on social sustainability as demonstrated by the definition and application of home-care services and telemedicine approaches (Yellowlees et al., 2010).

Analysing the sustainable approaches, technological and innovative solutions could be also studied considering the healthcare context of reference. The included results demonstrated that the main interest about sustainability could be emphasized within the organizational settings and in particular, the hospital one, with a focus on some operational unit or processes. Laboratories (Fragão-Marques et al., 2022), primary care centres (Morell-Santandreu et al., 2021) and operating rooms (de Ridder et al., 2022) could experience advantages applying waste and lean management principles to reduce the environmental impacts and supporting a high level of quality and assistance. Also, healthcare industries operate to support the green transformation of the sector using environmental-friendly materials for their device and acting with a multi-perspective approach among the entire supply chain, supported also by informatic integrated systems. Only some studies were implemented in the context related to patients' home, in case of telemedicine approach and implementation.

Clinical setting as the rare diseases (Saviano et al., 2019), the cataract surgery (Thiel et al., 2017) or the oral health (Martin et al., 2021; Mulligan et al., 2021; Jin et al., 2021) are presented as contexts in which technological advances and innovative materials could reduce the carbon footprint and the pollutant emissions.

4 Conclusion

The evidence reported in the literature demonstrated that healthcare sustainability is a wider theme, characterized by an elevated level of novelty, which could be declined in different research areas or fields of application, thus answering to the first research question (RQ1). Some authors stated possible definitions for healthcare sustainability but also addressed the issue from different perspectives, defining a relationship between sustainability, both from

an environmental and social perspective, and technological improvements within the healthcare sector.

The analysis pointed out the possibility to stratify the results concerning some literature streams mostly related to different technologies (i.e., medical devices and digital tools as IoT or artificial intelligence algorithms) and models, responding to respectively the third and second research question (RQ3 and RQ2).

Despite this, some models and technologies were defined or used considering applications on local data and/or settings, giving a reply to the fourth research question (RQ4): many studies are based on data collection conducted at hospital level or due to the enrolment of a national panel of experts. This could generate replication and generalization issues in the evidence proposed.

Valuable framework for identifying and prioritizing the key factors affecting sustainability in the healthcare facilities or, extending the horizon of analysis, at the healthcare systems' level, could also be used by healthcare professionals and policymakers to develop strategies and policies to improve sustainability, guiding the sector into a sustainable transformation, promoted at all the national and international levels.

Furthermore, all the literature streams underlined during the analysis pointed out the necessity of integrating sustainability into the value-based approach used in the healthcare contexts, notably, in the hospitals (Falivena & Palozzi, 2019).

As detailed above, in the literature evidence, various environmental indications related to sustainable management and green healthcare are presented, but there is still a great need of research for supporting policymakers and healthcare practitioners in addressing the problem of healthcare pollution (Sherman et al., 2020). Furthermore, the COVID-19 pandemic has pinpointed the relevance of the social sustainability by highlighting the COVID-19's impacts on patients (and worldwide population) health and quality of life (Ranjbari et al., 2021).

The review is a first attempt to systematise the evidence presented in the literature considering the strong relationship between technologies and sustainability, also highlights the models developed to assess the degree of sustainability, both from a social and environmental point of view.

Considering managerial implications, among all the industrial settings many companies are currently interested in declining this topic into their activities, transforming their business from a close perspective to a circular economy model, cooperating with other stakeholders and reaching high performance levels.

Also, healthcare industries and organizations, in particular hospitals, have started to change their paradigms of action and this new and green approach should be supported and encouraged also by scientists and scholars to collect and analyse data, through robust and systematic models.

Many models and assessment tools could be identified in the literature evidence, especially in relation to performance measurement, in comparison with studies dealing primarily with technologies: the applications of these models are still lacking in the real-world practice. In addition, the current studies related to technological aspects focus especially on digital devices and solutions.

The evidence coming from the review highlighted that the scholars have been able to provide models and conceptual frameworks, while, on the other hand, the practitioners have not yet significantly applied these models to evaluate the innovative solutions and procedures sustainability.

Therefore, there emerges a gap which may be explored to understand whether the lack of applications is driven by the novelty and complexity of the models or whether the nature of the technologies requires other tools of evaluation, because the proposed actual frameworks are not suitable for the specific technology stage or life cycle. In addition, there might be a sort of gap in terms of the acceptability of the frameworks proposed to be applied in the real practice, and the economic dimension could weigh strongly as a decision-making dimension, especially in the technology governance and management, but also considering the sustainability assessment process.

In conclusion, future contributions could be devoted to defining how to bridge this gap, integrating all the sustainability dimensions and assuming a multidimensional perspective.

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The Marketing Role in Multi-Stakeholder Engagement: An Empirical Examination

Cristian Rizzo

University of Turin
Department of Management
Corso Unione Sovietica 218bis, Turin 10134, Italy

Augusto Bargoni

University of Turin
Department of Management
Corso Unione Sovietica 218bis, Turin 10134, Italy

Ciro Troise*

University of Turin
Department of Management
Corso Unione Sovietica 218bis, Turin 10134, Italy

Mark Anthony Camilleri

University of Malta
Department of Corporate Communication
MSD 2080, Malta

Stefano Bresciani

University of Turin
Department of Management
Corso Unione Sovietica 218bis, Turin 10134, Italy

** Corresponding author*

Abstract

The goal of stakeholder theory, which was primarily developed in the field of business ethics, is to examine the interactions between the company and all of the actors in its ecosystems. Despite the growing recognition of the significance of communication strategies focused on internal and external stakeholders, the role of marketing has been largely neglected. In this research we propose an empirical assessment of a marketing-based theoretical framework. The analysis is aimed at analysing how the components of

stakeholders' engagement (recognition, support, and dialogue), and knowledge exchange, affect stakeholders' response and firms' outcomes (financial performance, risk, and reputation).

Keywords – Stakeholder engagement, Strategies, Marketing, Knowledge exchange

Paper type - Academic Research Paper

1 Introduction

Stakeholder theory was largely developed in the field of business ethics with the aim of analysing the relationships enabled by the firm with all the actors in its ecosystems (Philips et al., 2003). More recent, it posits that corporations should pay attention to provide benefits not only to their shareholders, but also to internal and external stakeholders that may influence a firm's long-term profitability and sustainability (Hillebrand et al, 2011; Hult et al., 2011; Miles and Ringham, 2018; Sloan, 2009). This process led to value the needs and desires of several stakeholders, determining the development of "knowledge for value cocreation", which in turns may impact favourably on firm innovativeness and reputation (Wiesmeth, 2020, p. 310). However, despite the increasing importance recognized to communication strategies directed to internal and external stakeholder, marketing scholars limited their attention to customer engagement, as a primary source of firms' performances (Freeman et al., 2010; 2018).

Considering this, Aksoy et al. (2022) proposed a new stakeholder engagement framework that acknowledges the role of marketing communication strategies. Their framework is based on three dimensions of firms' stakeholder engagement, namely stakeholder recognition, support, and dialogue, impacting firms' retaliation or stakeholder contribution, that in turn influence firms' profitability from a financial, reputational, and risk-wise point of view.

The first driver included in the framework proposed by Aksoy et al. (2022), that is stakeholder recognition, refers to rights, feelings, and traditions experienced by a given group of stakeholder; the second driver (i.e., stakeholder support) regards the direct actions and resources destined by the firm to guarantee stakeholders' well-being; the last driver (i.e., stakeholder dialogue) accounts for the mutual exchange of information, and ideas between the firms and the stakeholders. These three variables may impact the stakeholder perceptions in a positive

(stakeholder contribution) or in a negative way (retaliation) that may subsequently lead certain consequences in terms of profitability.

Despite the effort paid by Aksoy et al. (2022) to build a theoretical framework that emphasizes the role of marketing communication, less empirical attention has been devoted by marketing literature to analyse the impact of stakeholder engagement practices on firms' performances. To fill this gap, we propose an empirical study that assess the impact of stakeholder recognition, support, and dialogue on firm' performance, highlighting the mediating role of stakeholder responses (stakeholder contribution to the firm or retaliation). In addition, we show how stakeholder engagement practices may facilitate knowledge exchange by the sharing of information about firms' procedures thereby improving organizational learning initiatives.

This research posits the relevant role for marketing in the development of strategies able to effectively engage different groups of stakeholders. There are several reasons behind this. As the marketing function is responsible for communication destined to both internal and external stakeholders, it is of paramount importance for improving brand equity and to avoid possible reputational risks connected to the activity of the company. In addition, it is fundamental to understand the firm's competitive environment, as well as the need of all stakeholders with the final aim of offering them products and services that make them more satisfied.

Our results provide indications for managers and practitioners of multinational companies informing how they could adapt the marketing communication to cultural norms, and informal arrangements held by stakeholder groups belonging to different countries.

2 The stakeholder theory

Strategic management and organization theory both saw a rise in interest in stakeholder theory. Recently, different contributes have incorporated the stakeholder theory into the field of business ethics (e.g., Valentinov and Chia, 2022). The social responsibility component of stakeholder theory allowed the integration of social issues in management and more lately, it has started to take part in the discussion of sustainable development. (e.g., Steurer et al., 2005).

Stakeholder theory has been around for a while, but Freeman's work is largely responsible for its development. In response to growing globalization, increased

competition, and the complexity of business operations, the goal of his work was to outline an alternate style of strategic management. Due to public interest, increased media attention, worries about corporative governance, and its adoption as a policy within the context of the "Third Way", the stakeholder concept has grown in significance over time (Greenwood, 2008).

Companies, institutions, non-governmental groups, and the mainstream media all use the phrase "stakeholder" frequently. Despite the term's widespread use, many users fail to explain what they mean when they use it or give a particularly precise definition of what a stakeholder actually is. There is no one, clear-cut, widely-accepted definition of the term "stakeholder" despite the fact that various definitions of it have been proposed, even in the academic context.

Although researchers define the concept in a different way, they generally reflect the same principle—that the company should take into account the needs, interests, and impacts of individuals and organizations that either have an effect on or could have an effect on its policies—to a degree that differs from each definition.

In this framework, the interactions between the business and its stakeholders are bilateral and autonomous (Frooman, 1999). Fassin (2009) asserts that the Freeman (1984) model was possibly influenced by sociological aspects that indicates the incidence of relationships between individuals or groups. The classic capitalist view had an impact on the model's structure. Under this paradigm, the firm is solely tied to 4 group categories: suppliers, employees, shareholders, and the customers, who are the recipients of firms' production. Freeman (1984) however included other group categories that were impacted by business operations and viewed the firm as the hub of a number of interconnected interactions (Crane and Matten, 2004).

Freeman (1984), in his ground-breaking book "Stakeholder Management: A Stakeholder Approach", was the first to provide a definition of the stakeholder framework. To develop a stakeholder strategy, Freeman considered different academic works, including those on corporate strategy, systems theory, and CSR. He argued that both internal stakeholders (owners, clients, employees, and suppliers) and external stakeholders were experiencing these environmental "shifts". Based on this evidence, he advised managers to "consider all of those groups and individuals that can affect, or are affected by, the accomplishment of the business enterprise" as a result (Freeman, 1984, p. 25). He also suggested that stakeholders should be categorized, their interests should be better understood,

and their behavior should be predicted using marketing segmentation methods. To supplement Porter's list of general business strategies, he provided four generic stakeholder management strategies: exploit, defend, swing, and reinforce.

Freeman et al. (2010) particularly contend marketing may contribute significantly to the stakeholder theory. Indeed, compared to other fields, marketing has the tendency to express a greater consideration for external stakeholders. As a result, it is well-positioned to address issues related to managing and interacting with such stakeholders (Bhattacharya and Korschun, 2008).

3 A marketing approach to the stakeholder theory

Building on the relevance attributed to marketing, Aksoy et al. (2022) developed a new stakeholder engagement framework that acknowledges its role in the stakeholder theory. This framework grounds on three pillars, i.e., stakeholder recognition, support, and dialogue. These dimensions are likely to affect firms' retaliation or stakeholder contribution, that in turn influence firms' profitability from a financial, reputational, and risk-wise point of view.

3.1 Stakeholder recognition

Preliminary insights into the role of marketing in stakeholder recognition mainly regarded how stakeholders may react to marketing efforts and specifically to segmentation and targeting. These marketing strategies recognize some differences among consumers, and lead to differentiate communication strategies that signal how some categories of consumers are valued more by the company. Early studies and practice in this field were largely concerned with finding the firm's most valuable customers and crafting messages to appeal to them (Iyer et al., 2005).

The emphasis has typically been on matching the offering's usefulness and price to the user's demands. Yet, a limited concentration on customers and revenues frequently corresponds with disputes and moral issues, leading to negative stakeholder reactions. Reduced consumer spending is one result, but others include bad publicity, expensive restrictions, divestments, and boycotts (Herhausen et al., 2019).

Based on these premises, Aksoy et al. (2022) defined stakeholder recognition as a firm's consideration for emotions, well-being, and rights of a stakeholder group.

3.2 Stakeholder support

Depending on how each stakeholder group assesses the firm's initiatives, stakeholder reaction may be positive or negative. Stakeholder support captures marketing initiatives that provide monetary returns to various stakeholder categories. According to Wagner et al. (2009), stakeholders frequently evaluate the sincerity of a company's generosity or dishonesty in corporate communications when evaluating the company's programs. A possible factor influencing consumers' unfavourable reactions, according to Vila and Bharadwaj (2017), is mistrust in the firm's intentions. Practices like "greenwashing", which involves companies claiming that their products are environmentally friendly, or "brown washing" which involves companies being overly modest about their sustainability practices to draw attention away from potentially contentious activities, can have a negative impact on stakeholder response (e.g., negative WOM).

3.3 Stakeholder dialogue

Customers are the primary focus of current studies on stakeholder interaction, which can help us comprehend marketing's function in stakeholder dialogue. Consumers are frequently seen as fictitious marketers for the company who assist to crucial marketing activities like WOM or C2C communication for post-purchase assistance. It acknowledges that customers have a value for the firm that go beyond their financial expenses (Harmeling et al., 2017), and therefore useful in spreading the company's ideas within their communities since they are extremely convincing among other customers.

Marketing strategies that promote stakeholder interaction frequently employ a range of financial and non-financial rewards, as well as building an environment that promotes this kind of communication. For instance, businesses create communities to promote customer-to-customer C2C dialogue to promote consumers' feedbacks on product offerings. Even though the conversation on interaction can provide insight into how businesses communicate with their major stakeholders, this has generally concentrated on two of them: the consumer and, more lately, the employee (Kumar and Pansari, 2016).

Stakeholder communication has gradually evolved into open forums with a company, made possible by internet-based technologies and services. Several

studies have confirmed that these open discussions can draw different stakeholder categories' interest or take place immediately among businesses and other stakeholder groups (Hewett et al., 2016). Hence, marketing programs that inspire, facilitate, and increase stakeholder engagement may either promote positive or negative stakeholder reactions with repercussions for the company. In conclusion, marketing significantly contributes to stakeholder participation through activities that increase their visibility to stakeholders, and subsequently encouraging them to support and promote discussions.

3.4 The mediating role of stakeholder response

Stakeholders' assessments of the company's conduct and their capacity to influence the achievements of the business through stakeholder reactions are key factors in determining the effectiveness of stakeholder participation. According to Freeman et al. (2007), a company's interactions and relationships with one stakeholder group can exert an impact on those relationships with other interested parties. The extent to which a company's behavior coincide with or depart from such principles, in addition to if the stakeholder views the company's activities as ethically appropriate, might depend on variations in personal values within stakeholder groups. These evaluations are prescriptive in nature because they assess whether stakeholders think how the company should behave.

If firms and stakeholders' beliefs are not aligned such activities may result in stakeholder retaliation, which then impacts the company' current results. If there is alignment, companies might anticipate favorable reactions from a certain stakeholder, such as resource donations. Such consumer reactions positively influence firms' profitability from a financial, reputational, and risk-wise point of view.

3.5 The moderating role of knowledge exchange

In this paper, we tried to extend the framework proposed by Aksoy (2022) considering the potential role of stakeholder engagement practices at affecting knowledge exchange between the stakeholders and the company.

The firms should promote stakeholder information sharing and mutual learning, opening novel perspectives and creative solutions for solving issues and pursuing future business potential (Jiang et al., 2020). Intimate ties make it easier

to transfer knowledge, especially tacit knowledge that is difficult to explicitly transfer across business borders. Effective knowledge transfer and reciprocal learning support organization' innovative repurposing of existing knowledge and novel idiosyncratic resources. Following this reasoning, Garcia-Sánchez et al. (2018) discover that paying attention to numerous stakeholder categories has a positive effect on business development.

For this kind of reasons, it is possible to hypothesize that knowledge sharing may reinforce the impact of stakeholders' engagement activities on firms' profitability.

4 Method

The present research has the objective to empirically tests and extends the theoretical framework proposed by Atsoy et al. (2022).

As we are at a very preliminary stage of the research, data collection will be divided in two phases.

At the first stage of the research, a focus group will be organized to develop useful measures to assess the examined constructs. Because of the absence of well-established measures for the components of stakeholders' engagement (i.e., recognition, support, and dialogue), we will develop three different scales. In the focus group, we will ask to academic experts and managers to identify some items to assess stakeholder recognition, support and dialogue. Based on this evidence, the authors of this research will develop the items of the scales. In doing so, similar items will be considered together and an item purification procedure will be applied to obtain a set of items for each construct.

As for stakeholder response, we will consider the six items scale developed by Gregoire and Fisher (2006) to assess customer retaliation; whereas, stakeholder resource contribution will be assessed with a new scale as for the components of stakeholders' engagement. The moderating variable, i.e., knowledge sharing, will be assessed by adapting the four-items scale by Holste and Fields (2010).

As for the outcomes, firms' financial performance and risk will be assessed by using balance sheets ratios; whereas, the reputational risk will be based on secondary data.

4.1 Findings and conclusions

The sample is made up of Italian companies listed in the stock exchange, and the empirical analysis conducted through Structural Equation Modelling (SEM). Grounding on Anderson and Gerbing's (1988) two-step procedure, we will first conduct a Confirmatory Factor Analysis (CFA) to assess the reliability of the scales adopted, and then a structural analysis to test possible relationships among the examined variables.

In terms of results, we expect that the components of stakeholder engagement may affect stakeholder response even though at a different extent (also by considering different stakeholders' types). More interestingly, we expect that the stakeholder response may mediate the effect of the components of engagement on specific outcomes. Indeed, it is possible that stakeholder recognition may affect firm reputation, but not the financial performance. Moreover, it is also reasonable that the relationships between the predictors and the dependent variables may be attenuated or amplified by knowledge exchange.

Based on the results of this study, it could be possible to improve our current understanding of how marketing strategies may contribute to the stakeholder theory. From a managerial point view, the results of this study could help managers and practitioners to identify useful strategies to involve more effectively specific types of stakeholder, by preventing retaliation and promoting firms' profitability.

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Organizing Knowledge Creation Processes in the Agri-Food Business: An Institutional Perspective in the Italian Context

Giuseppe Ceci*

Department of Management, Faculty of Economics
Sapienza University of Rome
Via del Castro Laurenziano, 9,Rome, Italy

Michela Iannotta

Department of Management, Faculty of Economics
Sapienza University of Rome
Via del Castro Laurenziano, 9,Rome, Italy

Mauro Gatti

Department of Management, Faculty of Economics
Sapienza University of Rome
Via del Castro Laurenziano, 9,Rome, Italy

** Corresponding author*

Abstract

The purpose of this research is to understand how Institutions influence the knowledge creation process in the agri-food sector. Based on Knowledge Creating theories we aim to examine how institutions shape knowledge creation processes in the Italian context. We employ a qualitative approach by conducting a document analysis that includes several organizational and institutional reports, survey data, and various public records. Our study is carried out in the Italian scenario in which the agri-food business represents a milestone of the Made in Italy economy worldwide, to create meaningful insights. From a theoretical view, this paper will extend knowledge management theories by providing an institutional perspective that will shed light on the important role of institutions in knowledge creation process. On the practical side, the results will be used by agri-food companies to promote new organizational frameworks capable of supporting knowledge creation processes in non-knowledge-intensive contexts, enhancing collaboration with institutional bodies, governments, and regional entities.

Keywords – Knowledge Economy, Knowledge management, Agri-food business, Knowledge creation process, Institutional theory

Paper type – Academic Research Paper

1 Introduction

According to Marcus Tullius Cicero, human knowledge has uncertain forms. It is impossible to have a global knowledge of reality. One should not lose awareness of the possibility of falling into error, even after researching knowledge for a while. Several authors define the modern economy as a Knowledge Economy (KE) to emphasize the importance of researching knowledge in its different forms: they consider knowledge as a primary, intangible asset for producing value, increasing productivity, and facilitating innovation. These scholars have frequently linked the KE concept to high-tech industries, highly skilled workers, and contexts that would foster the development of intellectual performance rather than physical. Machlup (1962) stated that in a knowledge-based economy, the role of knowledge has assumed greater importance over natural resources, physical capital, and low-skilled labor. Similarly, Powell & Snellman (2004) argued that the key component of a KE is a greater reliance on intellectual capabilities than on physical inputs or natural resources. These definitions apparently exclude sectors that are mainly typified for achieving significant competitive advantages through physical inputs and natural resources.

Our literary review showed that while organizational researchers have extensively investigated the KE area by examining knowledge-intensive sectors (Smith, 2000; Alvesson, 2004), rather less attention has been paid to those businesses that employ a low-skilled workforce and in which knowledge creation processes may look as less impacting. Since knowledge creation is a dialectical process, in which various contradictions are synthesized through dynamic interactions among individuals, the organization, and the environment (Nonaka & Toyama, 2002) we aim to investigate how institutions, t can contribute to fostering such interactions in the agri-food sector. The agri-food sector represents a suitable scenario to conduct our analysis since 1) natural resources and physical capital are key factors 2) it is a sector that frequently employs a low-skilled workforce 3) it is undergoing profound changes that are affecting the need for innovative knowledge creation processes, displaying new opportunities and

challenges (Lowry, Avellan & Gilbertson, 2019). Our study will be realized through an institutional lens, to deeply understand how institutions affect the knowledge creation processes in agri-food organizations. We argue that investigating this phenomenon from an institutional perspective is crucial given that this sector, which has tended to be recognized as non-knowledge-intensive, is going through a phase of profound knowledge renewal that needs to be supported by the institutional framework. In institutional theories, organizations are influenced by normative pressures, sometimes arising from external sources such as the state, other times arising from within the organization itself (Zucker 1987). As per Hamdouch, & Moulaert, (2006) institutions and their policies contribute significantly to coordinating the different actors in the knowledge infrastructure and to the initiation of collaborative arrangements among them, along with the provision of significant funding and administrative and technical support for innovation and knowledge activities.

With this regard, we aim to uncover which is the role of institutions in the earliest phase of knowledge creation process within agri-food organizations.

Our research question is as follows:

> *How do institutions affect knowledge creation process in the agri-food business?*

To address our research question, we decided to carry out our analysis in the Italian context, where the agri-food sector represents one of the driving forces of the Italian economy abroad, spreading the "Made in Italy" brand worldwide (Montanino et al, 2021).

We argue that from a theoretical perspective, this paper will extend knowledge management theories by providing an institutional perspective that will shed light on the important role of institutions in knowledge creation processes. Moreover, the managerial implications of this study may add novelty to KM theories by highlighting the importance of considering the institutional influence in strategic choices. On the practical side, the results will be used by agri-food companies to promote new organizational frameworks capable of supporting knowledge creation processes in non-knowledge-intensive contexts.

2 Theoretical Background

The knowledge creating theories are deeply rooted in the field of Knowledge Management (KM). KM area deepens the role of the explicit and systematic management of vital knowledge - and its associated processes of creation, organization, diffusion, use and exploitation, in pursuit of organizational objectives (Skyrme, 1999). With this regard, KM activities are process-oriented: knowledge is supposed to flow within the organization following a predefined and iterative pattern in which knowledge creation represents the first strategic objective. Nearly all approaches to KM emphasize the process character with inter-linked knowledge processing tasks or core activities (Mertins et al, 2000). However, these processes seem to be more important for companies working in dynamic contexts, where rapid changes in the technological paradigm require that knowledge can be catalyzed quickly within different organizational levels.

Our literature review uncovers a massive body of materials that suggest that in knowledge-intensive sectors - which are characterized by the need to process and use knowledge on a daily basis in order to remain competitive - the knowledge creation process is formalized for both small-medium enterprises (Baptista Nunes et al, 2006; Durst & Runar Edvardsson, 2012) and big enterprises (Jiménez-Jiménez, Martínez-Costa, & Sanz-Valle, 2014). At the same time, our research reveals that scholars did not provide sufficient insights into those sectors in which the knowledge paradigm seems to be less prominent. For these reasons we decided to conduct our analysis in the agri-food sector which has been characterized by the dominant role of natural and physical resources.

The main contributions in this area combine different analyses that are not focused on a specific level of the KM process but refer to KM processes as a whole: Boshkoska et al. (2018) identify knowledge boundaries in agricultural value chains, Howland et al. (2015) understand attitudes, skills, and practices of fruit growers and define the necessary conditions for effective information sharing. Similarly, Meijer et al. (2015) built an analytical framework combining extrinsic and intrinsic factors in farmers' decisions to adopt new agricultural technologies. The valuable contribution of these studies underlines that knowledge is a critical enabling factor for healthy agri-food systems and is required to generate contextual information and processes to improve productivity, increase profitability, reliability, and resilience (Qaim, 2017). Analogously per Nonaka & Toyama (2003) the knowledge-creating process is necessarily context-specific in

terms of time, space, and relationship with others. Knowledge cannot be created in vacuum, and needs a place where information is given meaning through interpretation to become knowledge. To avoid terminological ambiguities, in this study, while mentioning the term "knowledge" we will refer to the concept of explicit knowledge proposed by Nonaka & Konno (1998). While tacit knowledge is deeply rooted in an individual's actions and experience as well as in the ideals, values, or emotions he or she embraces, explicit knowledge can be expressed in words and numbers and shared in the form of data, scientific formulas, specifications, manuals, and the like. This kind of knowledge can be easily transmitted between individuals in a formal and systematic way. This definition represents a crucial point in this work because institutions, following the same logic, may play a role in transmitting the same information and knowledge within organizations in a formal and systematic way in order to support KM processes in each phase. The theoretical purpose of our study is to investigate how the institutional framework influences agri-food business sectors at the specific level of the knowledge creation process (Fig.1).

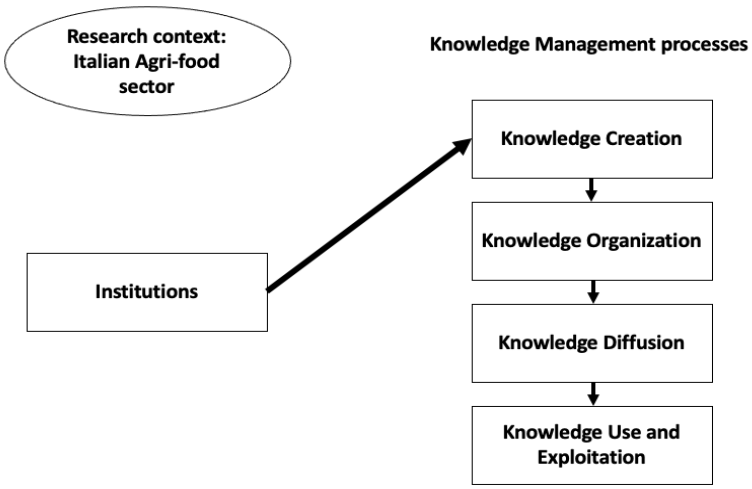

Figure 1: Proposed conceptual model as an application of Skyrme, 1999 (Source: Author)

3 Methods

The paper employs a qualitative approach by presenting a document analysis. We decided to choose the Italian agri-food sector for three main reasons. First, the Italian scenario represents one of the main competitors in the agri-food

business worldwide (Istat, 2023). Second, the extended agribusiness supply chain represents the leading economic sector in this country with a turnover of more than 500 billion euros and nearly 4 million people employed (Montanino et al, 2021): because of the strategic importance of this sector, our insights might be dense in significance both on a theoretical and practical level. Third, it competes in a high-technology industry that necessitates intensive cooperation between teams. In doing so, the company's WD had to strongly consider working relationships, interactions between different teams and different functions within the company. The unit of analysis is the knowledge creation process in the agri-food business. Data has been collected through documents, which include organizational and institutional reports, survey data, and various public records: these items represent our units of observation. Since there is no specific evidence of institutional effects on knowledge creation processes, these documents have been purposefully selected: purposeful sampling is a technique widely used in qualitative research for the identification and selection of information-rich cases for the most effective use of limited resources (Patton, 2002).

We defined two sampling criteria to collect our documents:

1. Documents were selected in a period of time going from 2020 to 2023.
2. Institutional reports were collected from all the public and semi-public agencies and political bodies (institutions as well as representatives) that intervene directly or indirectly in matters or domains linked to higher education, R&D and innovation, science and technology or industrial and regional development. Following this logic, we aim to build our data analysis on the definition given by Hamdouch, & Moulaert (2006). In their study institutions are considered as regular and lasting collective norms of behaviour and interaction play a crucial role for innovation and knowledge creation/accumulation/diffusion processes within a specific geographical space.

To support our analysis, data triangulation has been employed: this technique involves the use of different sources of data to examine phenomena across settings and at different points in time (Denzin, 1970). The documents have been analyzed in Italian language and then translated into English. Subsequently, a content analysis has been realized: this technique makes replicable and valid inferences from data to their context (Krippendorff, 1989) and moreover, it is reproducible with the document analysis methodology which is often used in combination with other qualitative research methods as a means of triangulation

(Bowen, 2009). Afterward, descriptive, and interpretive encoding has been performed using the software for qualitative analysis MAXQDA 2020. Emerging themes have been analyzed and discussed among the authors to present our results in the finding section. This approach was employed to explore emerging factors affecting Skyrme's (1999) theoretical framework and knowledge creating process as a whole.

The results of the case study are presented in a narrative form, in the next section.

4 Findings

Our findings are summarized in this section. They emphasize three different institutional levels of impact and three emerging themes for each code:

1. **Sustainable Level:** support and education projects on sustainable topics; reducing food and water wasting; encouraging renewable energies.
2. **Digitalization Level:** absence of investment in e-commerce platform for small-medium enterprises; aligning digital competencies and investments; food traceability; food traceability (Logistics and Blockchain).
3. **Contingent Level**: institutional support size-based; institutional sustainability; special focus on Mezzogiorno Regions.

Table 1: Sustainable Level

Type of Document, Name, Year	Text	Code
Institutional report; Obiettivo 2030 Earth Day Italia; 2022	The project support 60 farms in the Sienese territory in a process of growth and introduction of new precision agriculture tools for sustainable development in the areas of viticulture, olive growing and cereal growing.	**Support and education projects on sustainable topics**
Online Journal Bologna Today; Nasce 'Food-ER': atenei e imprese insieme nell'università dell'agroalimentare; 2023	'Food-ER, Emilia-Romagna International Network for Education and Industrial Research on Food and Beverage' is the network wanted by the Region that brings together first and foremost the four regional universities, the founding partners: of Parma - project leader -, Modena and Reggio Emilia, Bologna, Ferrara.	

Online Journal Agrifood.tech; Innovare il settore agrifood con il digitale per indirizzare le sfide globali di sostenibilità, tracciabilità e sicurezza; 2023	NRP, which allocates 1,200 million euros to the chapter "Supply Chain and District Contracts," setting itself the goal of reducing the use of pesticides; boosting organic farming; and reducing food losses and waste.	**Reducing food and water wasting**
Institutional report, Investimento 4.3 - Investimenti nella resilienza dell'agrosistema irriguo per una migliore gestione delle risorse idriche; 2022	The objective of this measure is to increase the efficiency of irrigation systems through the development of innovative and digitized infrastructure for a more sustainable agricultural sector that is better adapted to climate change. The investment will consist of converting irrigation systems to more efficient systems; upgrading distribution networks to reduce losses; and installing technologies for efficient use of water resources, such as meters and remote-control systems. For each intervention on distribution networks, meters enabling the measurement of water uses must be provided or installed as part of the financed investment.	
Report Istat; Economia e Legislazione agricola: L'agricoltura non aggancia la ripresa ma può contare su misure straordinarie; 2022	The Agrisolar Park aims to encourage the production of renewable energy through the modernization of rooftops of buildings for productive use in the agricultural, livestock and agro-industrial sectors, thereby increasing sustainability, resilience, green transition and energy efficiency in the sector.	**Encouraging renewable energies**

Table 2: Digitalization Level

Type of Document, Name, Year	**Text**	**Code**
Institutional report; Obiettivo 2030 Earth Day Italia; 2022	Only 30 percent of companies had invested in the e-commerce channel. The phenomenon of digital transformation is affecting any market: agribusinesses should also turn to online sales channels.	**No investment on e-commerce platforms for Small-medium enterprises**
Video interview Dr. Stefano Firpo, Chief of Cabinet of the Minister of Digital Transition; **"**PNRR E DIGITALIZZAZIONE DELLE PMI, QUALI OPPORTUNITÀ PER L'AGROALIMENTARE"; 2021	For our best companies we need to act on two fronts to have a greater capacity to absorb technologies and a greater capacity of our people to have the culture and skills adapted to the undergirding of these technologies because without these two things together we create bottlenecks. The national resilience recovery plan seeks to address this dual asset by investing heavily in technology as well to the mentioned some pillars for small and medium enterprises.	**Aligning digital competences and investments**

Online Journal Agrifood.tech; Innovare il settore agrifood con il digitale per indirizzare le sfide globali di sostenibilità, tracciabilità e sicurezza; 2023	It is noted that the areas most affected by 4.0 are those of production, logistics and food traceability; in which projects based on technologies such as Blockchain are spreading, to which agrifood is increasingly looking at with greater interest. In this regard, Corbo points out that globally, agrifood remains one of the sectors with the greatest presence of blockchain projects, testifying to how this technology can bring value to the sector.	**Food traceability (Logistics and Blockchain)**
Ministerial decree, Sviluppo logistica agroalimentare nelle aree portuali, 2022	Logistics development for agribusiness, fishery and aquaculture, forestry, floriculture and nursery sectors, with special reference to the purpose of agribusiness logistics development in port areas, to which resources amounting to 150 million euros are dedicated from PNRR funds.	

Table 3: Contingent Level

Type of Document; Name; Year	**Text**	**Code**
Ministerial decree; Contratti per la logistica nei settori agroalimentare, pesca e acquacoltura, silvicoltura, floricoltura e vivaismo; (D.M. 13 giugno 2022)	Aid intensity to strengthen logistics and storage systems, reduce environmental and economic and support productive processes is determined according to the Company size.	**Institutional support size-based**
European Regulation; Regulation (EU) No 651/2014 in the field of research, development, and innovation; 2022	Aid exempted in the field of research, development, and innovation. Higher maximum aid intensity for small and medium-sized enterprises than for large enterprises	
Video interview Franco Garofalo Managing authority PSR Umbria 2014-2022; Dialoghi con le Istituzioni: i focus sul CSR per l'Umbria 2023 - 2027 ad AgriUmbria 2023; 2023	We must not forget another kind of sustainability, the "institutional sustainability", that type of sustainability that puts the institutions - in particular the region of Umbria in building a program always closer to the citizens, always closer to the farmers. Clear rules and simple ones that can be somewhat welcomed and favorable in some way by the agricultural entrepreneurs in our region.	**Institutional Sustainability**

Institutional report; Gazzetta ufficiale della repubblica italiana 18/08/22 Tab 2A; 2022	Investment aid in the processing of agricultural products and commercialization of agricultural products. Maximum facilitation to Less Developed Regions and all regions whose gross domestic product (GDP) per capita during the period from January 1, 2007, to December 31, 2013, was less than 75 % of the EU-25 average for the period but greater than 75 % of the EU-27 average GDP	**Special Support to "Mezzogiorno" Regions**
Ministerial decree; Contratti per la logistica nei settori agroalimentare, pesca e acquacoltura, silvicoltura, floricoltura e vivaismo; (D.M. 13 giugno 2022)	Aid intensity is determined according to the Location of investment. Basilicata, Calabria, Campania, Apulia, and Sicily receive 10 % more than the other Italian regions	

4.1 Sustainable level

At this level, data (Tab.1) suggest that institutions play a key role in the knowledge creation process. First, by supporting existing and entrenched agri-food companies by directly adopting different technologies *in situ*. Second, by creating high-level training pathways for younger generations: the transition to sustainability, moreover, makes it necessary for emerging courses in higher education institutions to be contextualized at the sectoral level so that knowledge can be catalyzed within the organization. In fact, according to Istat (2021) a targeted education also greatly affects company innovation in the Italian scenario. In the case of a company led by people with a secondary education degree with an agricultural focus, the incidence of innovation is more than twice as high (23.9%) as the average value, and three times higher in the case of tertiary education degree specializing in agricultural subjects (30%). In addition, issues of wasting water and food must be part of the initial strategic objectives, and investments in instrumentation that can simultaneously increase product quality while reducing waste - and implementing renewable energies - follow this logic.

4.2 Digitalization level

The results, at this level, are ambiguous (Tab.2). On the one hand, the difficulty of small-medium enterprises in following the pace of large companies in terms of process digitization clearly emerges. The role of institutions in supporting knowledge creation processes takes the form of providing distinctive skills to

students and workers to avoid dangerous bottlenecks. This phenomenon had a significant impact during the pandemic period, creating substantial performance differences between small and large companies, and between companies in northern and southern Italy. Supporting our analysis, Istat (2021) report underlines the spatial distribution of IT equipment continues to penalize the Mezzogiorno Regions, (in this paper Mezzogiorno is composed by Basilicata, Calabria, Campania, Molise Puglia, Sicilia, Sardegna) which still suffer from a large gap compared to the Center, the Northwest and especially the Northeast part of Italy. Government support is maximum in the field of Blockchain, moving along the entire agri-food chain to encourage product traceability, avoiding the phenomena of "Made in Italy" brand counterfeiting, as well as ensuring increasingly high-quality standards.

4.3 Contingent level

It seems clear, as reported in the last section, that support from institutions concerning grants and financing takes on different values depending on whether small or large enterprises and between northern and southern enterprises (Tab.3). Aid moves on the spectrum of creating a balance at the country-level. Despite these interventions, it must be reported that according to Istat (2021) Italian agri-food sector is experiencing a reduction in absolute numbers of companies but a larger average size. Furthermore, while in previous sections we have emphasized the importance of aligning workers' skills with regulatory interventions according to a top-down approach, an interestingly different perspective emerges. Our findings extend the concept of institutional sustainability proposed by Brinkerhoff & Goldsmith, (1990) in their study on agricultural and rural development. These two authors define institutional sustainability in the ability of these entities to provide stakeholders with a continuing stream of benefits: our study emphasizes the importance of building subsidy measures on the concrete ability on the part of agri-food workers to clearly take in, at the beginning of the knowledge creation process, regulatory provisions and inputs from the external environment.

5 Discussion and conclusions

This research will contribute to the field of KM on both a theoretical and practical level.

First, this research advances our understanding of the influence of the institutional frameworks on the knowledge creation process in the Italian agri-food sector. Second, it emphasizes the importance of extending the knowledge creating theories by applying an institutional lens that can contribute to finding new emerging themes in order to apply this theory to the investigation of the antecedents of SEIs. Third, it will be beneficial to supply and motivate other studies and research in complementary fields, where our findings may be useful to respond to similar socio-economical contexts that received substantial support from the institutional framework in the knowledge creating process. Furthermore, through our research policymakers will be able to study ad hoc steps to enhance worker competencies: although higher education institutions are designing educational frameworks to create more and more trained professionals, it is clear that there is a lack of sufficient interventions aimed at supporting small and medium-sized enterprises in building, workers competences in line with today's digital transition - rather than sustainable transition - that they risk being swallowed up by the larger ones because they cannot access specific know-how.

Several limitations exist in the research. First, the scarcity of data combining knowledge creation processes and institutional theories in the agri-food business does not allow in-depth analysis to be conducted. Second, given the exploratory character of the study, the authors' data collection and interpretation may be vulnerable to criticism and prejudice. Third, it is difficult to isolate institutional influence on the knowledge creation process without exploring how institutions affect the subsequent stages of knowledge management process framework reported by Skyrme (1999) given the high interdependence between these stages. However, these limitations provide opportunities for further research.

Future research can 1) motivate our studies in this area, adopting an institutional lens to the other phases of KM processes 2) conduct the same analysis in the EU area in which the institutional frameworks might be different 3) realize a longitudinal study to understand how KM processes, and more specifically the knowledge creation processes have been changed in the last decade.

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Aluminium Alloy Roofing Systems for Sustainable Architecture

Giacomo Scrinzi*

Department of Architecture, Built environment and Construction Engineering at Politecnico di Milano
Via Giuseppe Ponzio 31, 20133 Milano, Italy

Enrico Sergio Mazzucchelli

Department of Architecture, Built environment and Construction Engineering at Politecnico di Milano
Via Giuseppe Ponzio 31, 20133 Milano, Italy

Sofia Pastori

Department of Architecture, Built environment and Construction Engineering at Politecnico di Milano
Via Giuseppe Ponzio 31, 20133 Milano, Italy

Angelo Lucchini

Department of Architecture, Built environment and Construction Engineering at Politecnico di Milano
Via Giuseppe Ponzio 31, 20133 Milano, Italy

Alberto Stefanazzi

Department of Architecture, Built environment and Construction Engineering at Politecnico di Milano
Via Giuseppe Ponzio 31, 20133 Milano, Italy

** Corresponding author*

Abstract

The present paper intends to advice readers about the potentialities of aluminium roofing systems in terms of general sustainability, recyclability, and achievement of energy requirements. The use of metal sheet panels for buildings roofing and cladding has been progressively increasing since the very beginning of the last century. Nowadays, several different products are available on the market, either basic or even highly engineered, in different materials, shapes, colours and, of course, prices. Among these, aluminium alloy

systems play a major role thanks to the material's inherent characteristics. For what concerns sustainability, aluminium production allows to use high contents of recycled material resulting in a reduction even over the 95% of the energy required in the process compared to the bauxite ore extraction and raw metal production. The total and theoretical infinite and degradation-less recyclability of aluminium when compared to other metals used in the roofing systems industry makes it easily preferable overall. Such solutions can either concern new roofs covering or refurbishment of existing ones. In the latter case, lots of construction waste is usually generated and eventually ends up in landfills. Instead, aluminium alloy roofing systems allow to be fully recycled and reused at the end of the service life, which is already longer than other non-metallic products, eventually reducing waste transferred to landfills. In fact, the higher cost of such material is largely compensated by its service life expectancy, which is among the longest lasting roofing materials and can reach up, in certain conditions, even to a hundred years. For this reason, complete replacement interventions are still quite uncommon, which favourably contributes on the final environmental impact of the roofing system. In this respect, aluminium alloy systems are particularly suitable, especially when compared with other different solutions, towards design for recyclability. Furthermore, aluminium systems are also indicated for rainwater harvesting purposes, as their surface retains less pollutants than other traditional porous materials and is less likely to give place to mold or concentrated collection of polluting particulates.

Keywords – Aluminium, Roofing Systems, Recycle, Sustainability, Certification.

Paper type – Practical Paper

1 Introduction

With a view to improving the overall quality of building, they are also required to be efficient and functional over their whole service life to fulfil sustainable requirements, where a key aspect is the selection of materials, which must be of high-quality while non-toxic, recyclable, cost and energy-efficient and functional (Radlbeck et al., 2018). Among many different solutions available for buildings roofing or cladding, the use of metal sheet panels systems has been progressively increasing since the very beginning of the last century due to their good compliance with such requirements and the perfect compliance with flat or curve surfaces (Figure 1). Nowadays, several different products are available on the market, either basic or even highly engineered, in different materials, shapes, colours and, of course, prices. Among these, aluminium alloy systems play a major role thanks to the material's inherent characteristics.



Figure 1. Technogym headquarter in Cesena, Iyaly (source: Arketipo).

In fact, for what concerns sustainability, aluminium production allows to use high contents of recycled material (generally >85%), resulting in a reduction even over the 95% of the energy required in the process compared to the bauxite ore extraction and raw metal production (Radlbeck et al., 2018), which also results in a heavy reduction of water and air pollution (considering SO_x, NO_x, and CO_2 emissions) up to the 95% (The Aluminium Association, 2023). The total and theoretical infinite and degradation-less recyclability of aluminium, when compared to other metals used in the roofing systems industry (such as steel, copper, zinc alloys, etc.), makes it easily preferable overall. In this regard, recycling is widely assumed to be environmentally beneficial, although the collection, sorting and processing of materials into new products could also entail significant environmental impacts (Craighill and Powell, 1996), thus they must be carefully considered.

In the view of energy performance optimisation, such solutions are also perfectly suitable to allow for the integration of photovoltaic modules (see Figure 2 and 5), either in co-planar or tilted configurations (Scrinzi et al., 2022), without perforating panels and instead using specific anchor clamps provided by manufacturers. This makes the use of such systems particularly intended for large, flat roofs or long slopes, also ensuring an efficient maintenance and an optimum reliability in terms of fire safety.

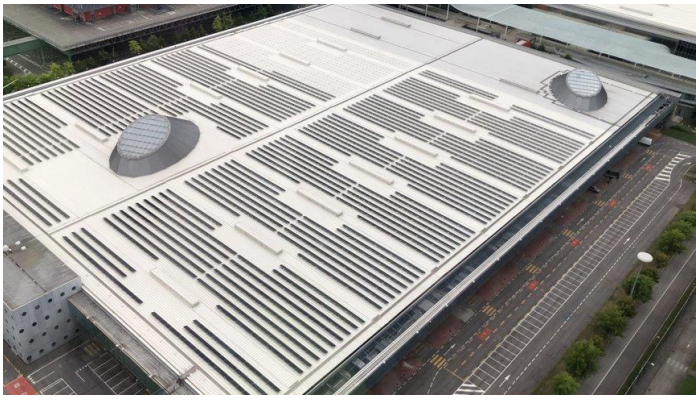

Figure 2. Fiera Milano exhibition centre (Rho-Pero, Milano, Italy) pavilions provided with roof-top tilted photovoltaic modules strings.

Roofing interventions can either concern new roofs covering or refurbishment of existing ones (Scrinzi et al., 2022). In the latter case, lots of construction waste is usually generated and eventually ends up in landfills. Instead, aluminium alloy roofing systems allow to be almost fully recycled and reused at the end of the service life, which is already longer than other non-metallic products (The Aluminium Association, 2023), eventually reducing waste transferred to landfills (Figure 3). In fact, the higher cost of such material is largely compensated by its service life expectancy, which is among the longest lasting roofing materials and can reach up, in ordinary conditions with extremely limited maintenance, even to a hundred years. For this reason, complete replacement interventions are still quite uncommon for projects realised in the last decades.



Figure 3. Demolition of Heathrow Terminal 2 (source: Stacey, 2015).

Furthermore, aluminium systems are particularly suitable to be used for rainwater harvesting purposes, as its surface retains less pollutants than other traditional porous materials (Mendez et al., 2010) (e.g., clay or stone tiles, asphalt shingles, etc.) and is less likely to give place to mould or concentrated collection of polluting particulates.

All the characteristics mentioned above make the use of aluminium a sustainable solution for roofing (also in general for construction) and particularly favourable towards the achievement of energy/sustainability certifications of buildings such as LEED (Leadership in Energy and Environmental Design), WELL (certification developed by the International WELL Building Institute), BREEAM (Building Research Establishment Environmental Assessment Method).

2 General characteristics of aluminium alloy roofing systems

Aluminium roofing systems have extremely interesting potentiality in terms of sustainability, recyclability, and achievement of energy or environmental impact requirements, which made the use of metal sheet systems for roofing has become more and more common over the years for buildings of any kind and size (Lucchini, 2000).

The most common systems are those referred to as “standing seam”, which are made of metal sheet coils profiled to obtain slender panels, generally with the same length of the slope. For aluminium alloys, depending on the roof usage, the environment and the in-service stresses, the sheet thickness generally ranges between 0,7 and 0,9 mm. Such panels can be anchored to the support using screws or equivalent connectors applied along the seam overlap (only for small roofs) or by special clips, specifically shaped to fit the panels profile, in turn screwed to the structural support. The latter category represents a necessary evolution of the basic plain metal sheet panels fixed onto a structural support, quite effective for small simple structures but less suitable to be used on large surfaces with significantly long slopes or complex buildings as they are not enough reliable for that purpose. Systems made of panels connected to the support by clips have had a wider application as they easily comply with different support types and envelope shapes (Bellini, 2012). Support clips, depending on the project requirements, are generally made of low-friction resin or aluminium alloy. In the latter case, they are fully recyclable as well.

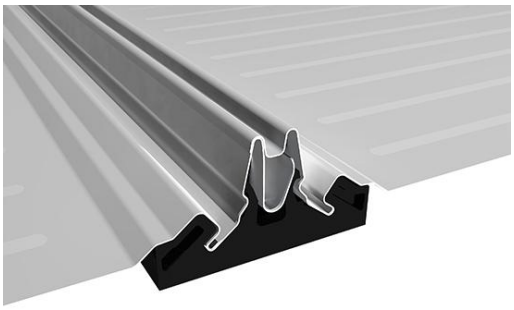

Figure 4. Example of a 3-pieces snap-lock standing seam roofing system components (source: ISCOM SpA).

The most innovative and well performing solutions available on the market adopt a snap-lock seam (two or three pieces) that provides the underlapping edge with a draining duct which guarantees an additional protection against water leading it to the eave in the case of small penetration through the panels seam, reasonably due to minimal production defects or to the wind pressure, also acting as a wind decompression chamber. Hence these are particularly suitable to be installed even on very low slope roofs (Scrinzi et al., 2022).

As stated before, aluminium alloy roofing systems easily allow for the installation on their top of coplanar or tilted photovoltaic strings. Photovoltaic modules are generally installed in both cases on aluminium frames, in turn attached to the roofing panels by using specific friction anchor clamps (Figure 5) without need of drilling and therefore avoiding any potential water seepage issues.



Figure 5. Example of tilted PV strings attached onto a flat standing seam roof.

3 Aluminium alloy roofing systems and sustainability

High-efficient buildings with low or zero energy consumption result nowadays to be way more environmentally impactful in the extraction of raw materials, production, transportation and end of life demolition and disposal stages, rather than in their service life. Therefore, it should be investigated how to achieve a reduction in such impact. The "Design for Disassembly" (DfD) is a principle applied during the design process that results in the detailing of reversible joints, connections and attachment mechanisms between building materials and components, thus enabling future reconfiguration, relocation, reuse and recycling. DfD approach eventually offers the opportunity to reduce the environmental impacts associated with both resource consumption and solid waste generation (Cruz Rios and Grau, 2020).

Aluminium roofing systems meet the DfD concept very well. In fact, the systems are designed to facilitate future changes and dismantlement (total or partial) for recovery of systems, components, and materials, thus ensuring a recycle as efficient as possible at the end of their lifespan. As described in chapter 2, a typical aluminium standing seam metal roof is installed on a structural support using a combination of metal/resin clips, fasteners, metal flashings, and of course metal sheet panels: all these components can be easily disassembled and therefore, if disposed properly, only a small fraction of the roofing waste will end up at the landfill.

Moreover, it should be highlighted that, for example, considering other typical roofing systems for residential projects, clay tiles and asphalt shingles roofs have a typical life span, respectively of about 30-40 and 15-20 years, while metal roofs can last even up to 100 years. The long-life span also means that an aluminium metal roof can result in a lower life-cycle cost. Usually, a metal roof is more expensive than roofs made with clay tiles or asphalt shingles but considering the savings due to its low maintenance requirements and durability, the total cost over its life span can be significantly less. While clay tiles and asphalt shingles could be recycled to be used as a filling compound and road hot mix asphalts, they still often end up in landfills. The recyclability of aluminium facilitates instead a closed-loop material flow.

Within an LCA, there are two approaches for assessing the benefits of recycling:

1. the recycled content method;
2. the end-of-life recycling method.

The recycled content method analyses where a material was sourced and measures waste diversion with the aim to promote a market for recycled materials which use is slightly diffused and often uneconomic. In 2006, all the metals industries recommended the end-of-life recycling method as the most appropriate for materials that fully maintain their material qualities when recycled time and time again (Atherton, 2007).

The end-of life recycling method is instead based on a product life cycle and material management perspective, assessing the destination of such products after their service life and the resultant material output flows.

The energy saved in the processing of new products thanks to the use of high ratios of recycled material can be recognized and rewarded in significant projects. For example, LEED rating considers the recycled content of the materials used. This recycled content is defined as the "Post Consumer" recycled content plus half the "Post Industrial" recycled content of building materials. Under the LEED program a building receives 1 point if the average recycled content of all the building materials used in the project is at least 5%, and 2 points if it is at least 10%. Since metals and particularly aluminium alloys can generally contain high volumes of recycled material (Figure 6), way higher than the average content in most of construction products, they may be helpful in obtaining specific environmental certifications.

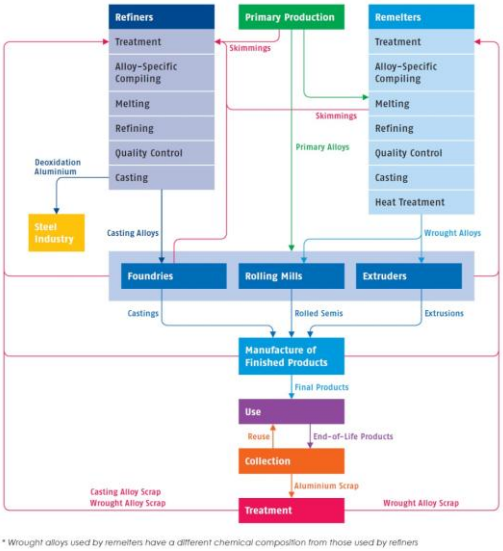

Figure 6. Stages in the production of aluminium components, including recycling (source: Stacey, 2015)

In order to investigate the impact and the possible advantages of aluminium alloy systems, the LCA (Life Cycle Assessment) methodology (Roy et al., 2022; European Aluminium, 2023) should be used. LCA is a standardized and internationally recognized method for the environmental effects evaluation of a product, process, activity or service. A complete LCA should include all phases of the life cycle (in the construction sector: production of elements/components, transport to the construction site, building construction, building use/maintenance, demolition and waste disposal/reuse/recycle), requiring a considerable amount of time and economic resources. For this reason, the LCA can be limited to a few phases, by specifying the considered system boundaries and the neglected processes. In this regard, the following possibilities can be considered:

- *from cradle to gate*, i.e. from the raw materials extraction to the final product leaving the production plant;
- *from cradle to grave*, which is the entire life cycle of the product, from raw materials extraction to the end of life;
- *from cradle to cradle*, when the product disposal at the end of its life is a recycling process;
- *from gate to gate*, therefore limited to the production phases, from the entrance gate to the exit gate of the plant;
- *from gate to grave*, from the plant exit gate to the end of life.

The methodology standardization introduced by ISO 14040 and ISO 14044 enables to perform and certify a LCA and guarantees the completeness, reliability and reproducibility of the analysis. The most complex and delicate part of the LCA is the data collection, since it is hard to find reliable and updated information regarding the analysed processes. However, in recent years, some databases have been created by different Research Institutes, collecting international, national or local data regarding the production of different materials and products. Moreover, producers themselves have started endowing their products with environmental certificates, such as the Environmental Product Declaration (EPD). These documents certify the environmental impact of the product or system analysed.

The life-cycle stages are identified by the standards in the following way:

- A1-A3, product stage;
- A4-A5, construction process stage;
- B1-B7, use stage;

- C1-C4, end of life stage;
- D, resource recovery stage.

For instance, Figure 7 shows the impacts expressed in terms of GWP (Global Warming Potential), PERT (Primary Energy Renewable Total) and PENRT (Primary Energy Non Renewable Total) of an aluminium alloy roofing system related to the stages A1-A3, C1-C4, D. Stages B1-B7 are not included since the product does not require any maintenance, repair, replacement, refurbishment, if correctly designed and installed. Regarding phase C, the system is disassembled with the use of an electric screwdriver and a crane, then the metal panels are sent to recycling directly without any processing, while the locking system is sent to landfill. Module D calculates the potential environmental benefits of the recycling or reuse of materials. The Net Value is the sum of the impacts of all the stages and represents the final impact of the product considering the whole life cycle.

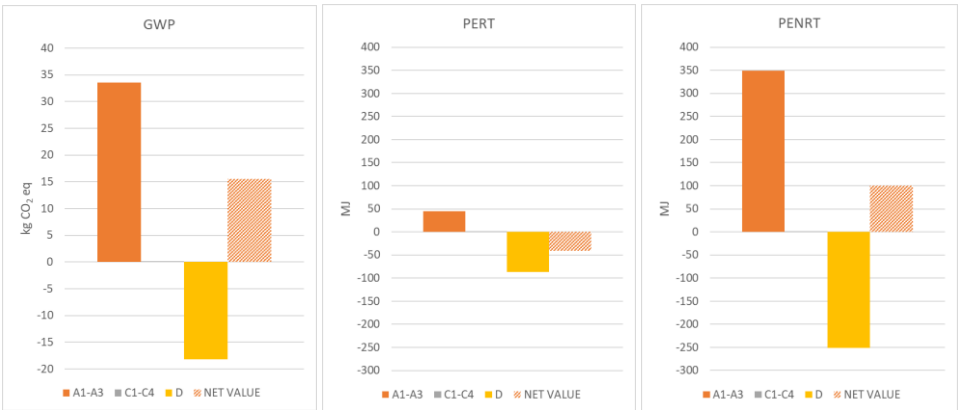

Figure 7. GWP (Global Warming Potential), PERT (Primary Energy Renewable Total) and PENRT (Primary Energy Non-Renewable Total) of aluminium alloy roofing systems related to the stages A1-A3, C1-C4, D. The net value is the sum of the impacts of all stages (source: ISCOM, 2022).

4 Conclusions

As presented above, standing seam roofing systems made of aluminium alloy present optimum characteristics in terms of recyclability and general sustainability. Recycled material content in newly manufactured aluminium products can reach over 85%, resulting in a 95% reduction of the process energy demand and the water and air pollution considering SO_X, NO_X, and CO_2

emissions. Moreover, the recycling process is theoretically infinite and degradation-less.

The service life expectancy for such systems just with basic maintenance duty is one of the highest among roofing materials, reaching up in optimum conditions even to a hundred years. They are also capable to easily allow for the integration of photovoltaic power plants in different configurations with good aesthetic results and without compromising at all the roof durability over years.

Rainwater harvesting is also possible and particularly indicated for such systems due to the minor pollutants collection on metal panels' surface and the less likelihood to give place to mould.

The use of such systems is particularly encouraged even in complex projects, either for flat or curve roof geometries, in order to comply with specific certification (such as LEED, WELL, BREEAM) requirements.

Standing seam roofing systems are also perfectly meeting the "design for disassembly" principle, as construction joints are fully reversible and not permanent. In this way, metal panels can be easily detached, reduced in smaller parts and transferred to recycling facilities, as well as support clips in case they are made of aluminium alloy too, eventually drastically reducing the quantity of materials conferred to landfills.

The material production stage (A1-A3) is the most impactful phase in terms of GWP and Primary Energy (PERT+PENRT) use. However, by considering the whole product life-cycle, a reduction in the global impact is achieved thanks to the material recycling, with approximately 55% and 85% decrease in GWP and Primary Energy consumption, respectively.

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Cryptocurrency, Fintech and Islamic Entrepreneurs: Shaping the Prospects of the Islamic Digital Economic System

Gioia Arnone*

Department of Management and Quantitative Studies
University of Napoli "Parthenope"
Via Gen. Parisi, 13 - 80132 Naples

Gunawan A. Tauda

Faculty of Law, Universitas Khairun
Jl. Jusuf Abdulrahman, Kampus Gambesi
Kota Ternate, Provinsi Maluku Utara, Indonesia

* *Corresponding author*

Abstract

The research identifies the essential fintech solutions available in the Islamic nations and the shaping factors that are classified based on the economic growth. For accomplishing the goals of the current study, a qualitative secondary research survey is conducted. The study involves collection of 30 research journals from the leading Islamic web sites. Data have been analyzed for shaping perspectives of economic development as per Sharia Law. The results indicated that there is a need for development of existing services and enhancing the use of fintech technologies. The proper regulation of cryptocurrency based on Sharia compliance was analyzed and the study findings indicated that Islamic entrepreneurship needs to emphasise more on the technology development and marketing. The overall shaping prospects and regulations parameters for the Islamic digital economic system are processed as per the Sharia law and the beliefs of Muslim people. The study states that the Economic factors such as Fintech, Cryptocurrency, and Entrepreneurship must be more transparent, cost-effective and must provide effective customer satisfaction.

Keywords – Fintech, Cryptocurrency, Entrepreneurship, Sharia law, Blockchain

Paper type – Academic Research Paper

1 Introduction

Financial technology (Fintech) has gained immense popularity and is considered as a developing segment of the modern finance industry. In the banking and financial sectors, financial technology has gained immense traction and is the quickest expanding technology. Fintech refers to the use of cutting-edge technology in the financial world. Fintech effectively adopts the disruptive innovative technologies to provide financial services. It can be defined as a form of financial solution to the economic issues that are relevant in context of the advanced technologies and helps in addressing the investors' demand for enhanced safety by creating unique and efficient financial products. Another important reason for Fintech's popularity is the demand for more economical payment systems that provides flexibility and speed (Anikina et al., 2016).

Through open accessibility, reduction in cost, elimination of intermediaries and quicker availability of financial statistics, fintech seems to have a positive impact on the quality of existence. In fact, fintech services emerge as a potential solution to connect all those individuals who are not represented by traditional financial services. The 2008 global financial crisis was the primary reason that evoked the development of financial technology (Haddad, 2018) and provoked the Islamic economic technology to emerge as a medium for economic crisis rehabilitation. Consumers made wrong financial decisions during the Global Recession and, consequently, the need for solutions that provide consumers with much more certainty in regards to financial investments emerged. The majority of Chinese banks and financial institutions are concentrating on enhancing the technological and financial services, by investing in domains like artificial intelligence, blockchain, and big data. Fintech has grown significantly as a result of the widespread adoption of digitalization. The financial technology business has displayed immense advancement since 2011.

Fintech additionally assists in the collection and distribution of Islamic social finances including infaq, sadaqah, and waqf (Alam, 2019). Financial services give the Islamic banking system and other shariah-compliant financial organisations the optimal potential to grow in magnitude and depth by utilising technology advancements, boosting revenues, and offering clients and customers with comfort and efficiency in business operations. Fintech could assist Islamic Finance Institutions (IFIs) to compete on a global scale and consequently acquire more customers. Although, a small portion of individuals prefer to conduct business in

a physical location. As a result, Islamic finance considers the possibilities of conducting business through the online platform.

Fan et al. (2019) asserted that even though Islamic economic nations have a lot of economic inclusivity, nations with traditional finance have a huge amount of financial technology consumers. Fintech is used to provide Shariah-compliant services and operates as per the consumers' convenience, is swift and much more affordable over other options because it is supported by technological innovations (Todorof, 2018). As defined by Navaretti (2018), Fintech includes four categories: (i) investment management systems, such as trade; (ii) insurers; (iii) credits, deposit, and wealth facilities; and (iv) transactions, clearance, and settlement services which includes virtual currencies.

Cryptocurrency is an emerging new virtual payment method that is startling the banking world with its global spread. Since 2008, cryptocurrency has grown in popularity, with over 1,000 distinct currencies presently in circulation and an ever-increasing market valuation as a result of its purported rising popularity (Gantori et al, 2018).

In 2009, Satoshi Nakamoto issued a policy statement discussing the significance, approach, and programme code for blockchain technology implementation (A brief history of cryptocurrency, 2018). For first time, a program enabled unrelated transactions to transfer virtual currency on a real-time basis without a potential source was developed. Following this, the nodes in the network register the transaction inside a distributed public repository known as blockchain (Biella and Zinetti, 2016).

Virtual currencies were the creation of such a Block Chain Management System (BMS) that is a conscious framework for exchanging numeric data from one address to another. It may appear difficult for the currency to be erased in transmission among the different wallets and for these transactions to be double-spending. Although, the emergence of cryptocurrencies has grown throughout the globe, there have been a diversity of regulatory responses. Because restrictions vary from country to country, there is a great deal of variation in the availability of bitcoin. Countries such as China and the Philippines have prohibited the use of cryptocurrencies, while some countries have allowed full access to cryptocurrency trading. Moreover, other countries have regulated the use of cryptocurrency (Hua and Zheng, 2019). Islamic banking offers a variety of customer details, one being foreign currency trading, also known as al-sharf. Currency exchange trade is already regulated under Islamic banking regulation.

The global commerce of products or services between states has given rise to international trading activities.

Every nation has certain laws and it varies from one another in respect to the deviations in the markets between these nations, leading to exchange rate evaluations. Although it is usually necessary to exchange currencies (Al-Sharf), typically among the same currencies, either between separate means of payment or for a distinct range of elements as specified by Rivai (2011). As the Islamic Finance industry develops, there is a high chance for the emergence of new technologies. In this context, one of the most exciting developments that have had a major influence is the emergence of Cryptocurrencies. Moreover, with the emergence of Blockchain technology, a new approach for Islamic banking and finance based on Shariah or Islamic Law has emerged. Islamists are more concerned about entrepreneurship, that is regarded as the most crucial aspect in the financial survival and growth of organizations. Entrepreneurship is the most important factor in the development of the economy and expansion. Governments with a strong entrepreneurial culture see rapid expansion in all areas, including occupation, revenue, technical advancement and balanced wealth distribution, stability and socio-economic sustainability. Moreover, in order for companies to operate effectively, knowledge management needs to be supported by technology. Knowledge management can be enhanced by technologies that creates innovative techniques, methods, processes, and strategies in order for the creation, dissemination, sharing, and applying of new knowledge, anywhere, anytime, across internal and external teams, and/or organizations, particularly to their stakeholders, suppliers, partners, users, etc. Because of the extensive importance of entrepreneurial behavior in economy and culture, Islam proposes the idea of entrepreneurship as a religion. In comparison with traditional entrepreneurship, Islamic entrepreneurship is more dynamic and holistic (Shinkafi and Ali, 2018). In contrast to the traditional entrepreneurs, that relied exclusively on financial gains, the aspect of Islamic entrepreneurship targets socio- economic growth. The primary aim of the current study is to identify the significant prospects for the Islamic digital economic system as a result of proper regulation of cryptocurrencies, fintech and entrepreneurship.

The rest of the paper discussed as follows: chapter 2 deals with the relevant literature review on the adoption of FinTech, blockchain, and cryptocurrency among Islamic Entrepreneurs as well as how these technologies have impacted the economic development of Islamic finance sector; chapter 3 deals with the

methodology that this study adopts; chapter 4 discusses with the analysis and findings of the current study; and the final Chapter 5 provides the conclusion for the study.

2 Literature Review

2.1 Islamic-based Fintech adoptions

Throughout the Islamic nations, Islamic finance, particularly, the Islamic FinTech has displayed a positive future and influential impact. The emergence of financial technology in such countries has been encouraged by the evolution of smart and digital assistant technology (Hua and Zheng, 2019). According to Brian et al. (2017), such possibilities hold immense risks. The major challenge for Islamist financial services is a lack of strong and solid studies in the field, as well as inadequate laws. According to another study conducted by Firmansyah (2018), the existence of Muslim Fintech startups could effectively assist entrepreneurs. Although it is a significant benefit for fresh graduates, few firms offer Sharia-compliant funding to extremely competent financing prospects.

Since 2008, financial services have grown at twice the rate in the European area, nearly triple the rate in Silicon Valley. During 2011, the number of financial technology operations within the UK increased, accounting for more than half of all international transactions (Skan, 2014). There's still an opportunity for future fintech businesses that can be realized across a financial service provider and client respect. It is important for the formation of financial organizations and banking institutions for the growth and development of Fintech startups could provide consumers with the opportunity of using both banking services and innovative new support offered by financial institutions (Gomber, 2018). Financial services companies have allowed existing banking sectors a chance to offer low-cost digital financial services. Islamic financial technology is built on Sharia's values and ethos that have the capacity to influence the global financial sector. The most significant benefit of Islamic Financial technology is that it’s open, easily available and simple to use (Laldin, 2018).

Due to the obvious features of Islamic finance that have evolved as a substitute for traditional financial services, the global economic crisis had no impact on the financial process of the Islamic banking system. With such a rise of Sharia financial technology, Islamic financial institutions have the ability to improve the financial

world and establish themselves as independent financing with increased accountability and high ethical standards (Satyawati et al., 2017). As examined by Arize et al. (2018), technological advancements are simply the beginning of what is to follow in the banking and financial industries. Islamic financial institutions must be willing to test and adopt new things. Sharia-compliant Islamic Finance has the opportunity to encourage 150 million new clients over the next 3 years (Wonglimpiyarat, 2017).

Moreover, this is estimated to rise even more as analysts predict a rise in Muslim population expansion, also with the population of Muslims were expected to exceed three billion by 2060 (Cooper, 2018). According to research conducted by Cooper (2018), Indonesia, Malaysia, and the United Kingdom presently occupy the top 3 positions in terms of Islamist financial institutions. Another study conducted by Rusydiana (2018) highlighted a shortage of skilled human specialists as the most important hurdle to the introduction of Islamic financial technology. The number of economic service centers wherein Islamist financial technology could be related, for instance, cryptocurrency, blockchain technology as well as other fields like cross-border transactions could be related to the success of Islamic financial technology. Muslim Financial services have to adapt to the rapid growth in the traditional financial sector. Since the primary assumption of financial technology investment is in accordance with the standards established under Sharia law, Islamic banking offers more possibilities than financial services.

Islamic Financial services share the same fundamental beliefs and principles as Islamic Banking and finance (Alam, 2019). The rise of Muslim financial services expands opportunities for developing countries by providing a cost-effective alternative to the banking system. Conversely, it puts regulatory agencies on notification in order to maintain stability and protect individuals and organisations from unethical commercial practises (Saba, 2019). An effective mechanism must be established amongst university graduates who are employing technology to ensure that Islamic Financial Services flourish responsibly (Saad, 2019). Financial services should be inventive and it has to stay viable in the long term, as financial technology implementation by Islamic banking institutions influences not just the Islamic population but also non-Muslims, as well as the entire financial services sector (Irfan, 2019).

Fintech firms could be more conscious about the significant change happening the reputation in the industry, because that will have an effect on business, but

they should develop methods of dealing with all these developments (Lee and Shin, 2018).

2.2 Impact of big data-related fintech on Islamic economic development

FinTech solutions in Islamic finance must respect Islamic standards in transaction data, including transparency, avoidance of cheating, justice and fairness, deception, fraud, and so on. Authorities also should address the Compliance with shariah of financial technology functions and operations to minimize the risk of non-compliance and ensure that financial services function in a secure setting (Laldin, 2018). Technology in Islamic banking and finance must follow the same Shariah compliance standards as all other financial transactions. Financial technology solutions involve its unique system of rules to supervise the operations and processes in order to retain the integrity of Shariah-compliant financial stakeholders, satisfying societal demands to consequently reach Maqasid Shariah compliance. Given the potential of blockchain systems and the risks associated with their proper implementation as both time- and cost-saving, one of the various alternatives accessible in Islamic banking and finance is to use innovation as a motivator to build up organisations and improve efficiency (Ng and Kwok, 2017).

2.3 Impact of bitcoin and cryptocurrency in the Islamic economic development

A cryptocurrency is a form of digital currency that could be used as an exchange medium instead of fiat currency. This makes use of blockchains that creates a safe, traceable and permanent foundation for monetary transactions. According to the blockchain, the creation of extra resources is similarly regulated (Polansek, 2016).

According to Allison (2015), cryptocurrency systems, with the exception of standard central banking technologies and networking currency such as Amazon cash, should not have a centralised transmission system. Double spending is a major issue that each virtual money transfer system encounters. The term "double spending" refers to a business repeatedly spending the same amount of money. A base station maintains the account information in a digitized cash settlement system in order to prevent double-spending (Appelbaum, 2021). Virtual currency

networks do not have a centralised structure; instead, they are a decentralised system. As a result, the duty for maintaining a record and archive of every transaction, as well as all remittances, must be shared by peers, eliminating the potential of double-spending (Ameer, 2018).

The cryptocurrency payment process contains a component of gharar, since the true significance of such currencies is uncertainty, price levels are unpredictable, but there is variability within the measure of value and a proper approach for the desired value. Since the core concepts of banking indicate that gharar is also against the sharia law and therefore haram, gharar is described as ambiguity, dishonesty, and uncertainty (Abu Bakar, 2017). Gharar was an Arabic term for "selling something that does not already exist" (Ahmad, 2008). Other research on Bitcoin and other cryptocurrencies realized that because bitcoins seem to have no core value and are not regulated by a banking system, it could be easily exploited. Cryptocurrency also was regarded to be about Islam and must be banned since this undermines the central premise of the Islamic economic system which is economic equality. For such factors, bitcoins are regarded to be against Shariah and must be banned (Meera, 2018).

A large variety of digital currencies are now in circulation. Such virtual currencies might take a variety of shapes and employ a variety of algorithms. Furthermore, for such a cryptocurrency's long-term viability, legal compliance norms must be met. In this regard, a significant disadvantage of cryptocurrencies in the economy is that customers would lose money due to a lack of regulation. Each cryptocurrency must agree to and keep all essential requirements to be a protracted cryptocurrency (Billah, 2019).

Ibrahim (2017) found that the development of an Islamic virtual currency is viable. Cryptocurrencies are prohibited in parts of the world's major economies, including China and Russia, due to safety and insecurity (Siswantoro, 2020).

In Arab nations, virtual currencies face a different challenge: Shariah law compliance. Islamic countries such as Algeria, Pakistan, Morocco and Egypt had partially or entirely prohibited cryptocurrencies. The causes for such cryptocurrency's partial or full prohibition are such compatibility with Shariah Law and Religious education, about which different researchers have conflicting opinions. As a result, the purpose of acquiring cryptocurrency is an important factor in assessing whether it is permitted or restricted (Sami and Abdallah, 2020). Scholars typically believe it permissible if the major goal for inventing cryptocurrencies is to use them as an exchange medium. The researchers

investigated the greatest profit or loss achieved for the various virtual currencies that are permitted while keeping Islamic Sharia Law compliance in view.

2.4 Evolvement of entrepreneurship in the Islamic finance

According to Ramadani et al. (2015), Islam as a religion encourages all Islamists to be dynamic and productive, which are the qualities of successful professionals and entrepreneurs. Islam's primary principles support economic success by implementing correct use of the wealth provided by Allah. As a result, Shariah Law makes the distinction between what is halal and what is haram for Muslim people. According to Islam, mankind is the easiest technique of production as compared to other species, as revealed in the Holy Quran, and has been appointed as the protector of both the worlds, to not injure or cause any environmental damage.

In summary, Islamist entrepreneurship is according to Islamic law and values, as well as any business executives that follows these laws and concepts in their totality are regarded as a "Muslimpreneur" (that is a Muslim-entrepreneur). According to Gümüsay (2015), a study examining the role of spirituality in entrepreneurs and administration is lacking. Sharia entrepreneurship is a comparatively recent issue. Because of its importance in economic development and growth, it has attracted a lot of attention from scholars, academics and entrepreneurs. Prophet Muhammad believed that "Righteous business people will be the first to enter heaven," and "A truthful merchant will be raised on the Day of Judgment among the truthful and martyrs" (Azmi, 2017). Before declaring himself as a prophet, the Prophet was a businessman, a great successful entrepreneur based on honesty, integrity, trust and wisdom. Muslim women and men are highly encouraged to engage in authorized business endeavors, according to Islam. Prophet Muhammad's wife, Sayiditina Khadeejah bint Khuwaylid, was an example of a successful businesswoman. Islamist enterprise has received a booming reaction from business executives, academicians, entrepreneurs, researchers and policymakers, owing to serious concerns about environmental risks and public welfare. Islamic entrepreneurship not only helps businesses grow, but it also helps individuals trade while doing trade with people from different cultures (Shinkafi and Ali, 2018).

The value of assets held by Islamic banks was 1.7 billion US dollars in 2017; by 2023, it is expected that this figure will rise to 3.8 billion US dollars. Increasing

sharia-compliant product demand in emerging Islamic countries is the primary driver of this expansion, and the sector is getting better at meeting that demand. FinTech broadens financial access globally and, according to studies, will have a significant impact on Islamic financing. Despite the significant growth of the Islamic Fintech ecosystem, peer-to-peer lending has focused on meeting the critical demand for making Shariah-compliant funding more accessible to businesses and consumers (Panel and Gateway, 2019).

3 Methodology

The present study uses qualitative research and has conducted secondary survey research from the leading journals in order to shape the economic factors. The study involves collection of 30 research journals collected from the leading websites (Science direct, Web of Science, Research scholar, Google scholar) and also 10 articles that are collected from the leading Islamist sites (Islamic fintech alliance, SPCRD, Leveraging Islamic fintech). The data collected from the relevant sites is then analyzed for the shaping perspectives of economic development as per Sharia Law.

The economic prospects are shaped by analyzing the financial aspects to achieve the objectives of this study. Furthermore, the study also explains the regulatory provisions surrounding cryptocurrencies, financial technology and entrepreneurship programs.

The current research aimed to systematically respond to all the sequenced research question that helps to structure the conceptual research framework to achieve legally correct rules and regulations concerning the cryptographic digital currencies, impactful guidance for entrepreneurial businesses and the adoption of fintech depending on the existing economic and technical data. To frame a positive reliable assessment of such framework of generating the rational ruling and influencing the economic outlook of Islamists, systematic research questionnaires in the pertinent system started with core problems and then moved into information related to encoded virtual currencies, the application of fintech solutions, and the impact of entrepreneurialism.

Some of the research questions for shaping the economic prospects of the Islamists are:

- What is the impact of cryptocurrency on Islamic finance development?

- Are cryptocurrency and virtual currency are legalized by Islamic countries?
- How much the Islamic entrepreneurship influences economic development?
- What are the difficulties in the Sharia compliance on entrepreneurship?
- Why the adoption of Fintech solutions is lagging in Islamic economic views?

4 Analysis and Findings

The descriptive strategy is proposed for achieving the research objectives in the qualitative study based on the secondary survey. The methodological survey questions and data are studied in order to shape the economic growth of Islamic nations through fintech, cryptocurrency, and entrepreneurship.

4.1 Benefits and Threats of Islamic Fintech implementation

The implementation of financial technology in the Islamic religion based on the shaping prospects of economic development are stated below:

- Establish, promote and enforce the frameworks in order to encourage Islamic banking and finance technology to promote participation and confidence;
- Support a network of inventors broaden the scope of Sharia compliance and impact of Islamic society in financial innovation;
- Acceptance of nine important fintech technologies: artificial intelligence, quantum computing, big data analytics, open banking, mobile payments, peer-to-peer financing, blockchain technology, cybersecurity, and cloud adoption;
- Consider externalities as a cause of financial market failure that should be regarded as a failure of commitment and should be avoided. The institutions and regulatory bodies should enact legislations that recognise the expenditure of rules as an external burden.
- Sharia compensation, as well as a comprehensive and principle-based approach to Fintech regulation, should be examined to address and alleviate challenges that financial authorities face when supervising financial enterprises during the economic downturn.

- By considering Sharia Law, to achieve a balance between the benefits of regulation and the risk it represents in addition to the greater threat;
- Need for an effective regulatory structure that does not overlap with current legislation (Hui et al., 2019).

4.2 Shaping prospects of Islamic economy by concerning cryptocurrency

Due to the lack of centralised regulation, cryptocurrencies differ from traditional currency and thus, all Islamic country needs build its own crypto legislation in order to effectively use cryptocurrency in the country. Eventually, the common regulation for the Gulf countries is much more important for economic development. Fraud and illegal activities should be prohibited in order to overcome negative ideology and feedbacks;

Furthermore, Sharia Law and Muslim Law relates to the evolving of cryptocurrency as a legal tender for the economic wealth of the nation. Therefore, any misconduct of a country's legislation, as well as the uncertainty regarding cryptocurrency adoption, should be regulated globally. It is not allowed to know the purpose of accumulating or investing in cryptocurrencies under Sharia law. Based on the principle and nature, the individual cryptocurrency must be analyzed before entering into the virtual currency market. The regulations are the most important perspective for effective economic development in the case of cryptocurrency (Shinkafi and Ali, 2018).

4.3 The importance of entrepreneurship in the shaping perspective

Islamic entrepreneurship is more delegated to the development of the economic prospects of the Islamic nations.

For successful entrepreneurship, access to market analysis, business information, and connections are required. Moreover, Customer activities, operational processes, efficient marketing, appropriate communication, and distribution of data are the most important aspects of entrepreneurship (Hoque et al., 2014). To focus on shaping the entrepreneurial perspective, it is necessary to reduce the cost of internal process operations and improve customer connections and partnerships. In fact, effective entrepreneurship necessitates the development of a new platform as well as the adjustment of an existing platform.

4.4 Knowledge Management in Islamic Digital Economic System

Finding trends that will result in competitive and innovative products and services, which will then spur development and profitability, requires a significant financing in research and development as well as market research. Due to the existing macroeconomic situation, banks should have the ability to convert data into knowledge which will be taken into account when developing plans. So that the proper course of action may be taken, this information can be employed. This has been an essential action in the knowledge management industry. Knowledge management ideas have been adopted in state financial institutions by the governors of numerous central banks of Islamic nations. They came to the conclusion that the fundamental reason for putting knowledge management into practise is to facilitate the communication and information-sharing among bank personnel. The World Bank demonstrated greater success in knowledge transfer than other institutions; however, it faces several challenges due to a lack of effective knowledge integration. This can be partially caused by the challenges associated with gathering and combining various data sources. The knowledge management concept which has seen banking organisations development strategy is still in its infancy. It has further intended that knowledge management will enable workers to share information or ideas, participate more actively, and feel more empowered to find solutions to issues (Cader et al., 2013).

Raising the quality and quantity of product innovations of Islamic banking is one method to put knowledge management into practise. Further, enhanced research and training are been helpful to Islamic banking to show improved performance. This is due to the fact that the knowledge management complexity in Islamic economic system has been influenced by factors such as integrated and synthesizing knowledge factors, openness of corporate boundaries, knowledge viewpoint, and knowledge quality (Nurdin et al., 2018). Since good business value, human resources, innovation, and knowledge management, are all strongly correlated, bank digital system must engage with research organisations and share their knowledge, rather than only relying on what is already known. They must also experiment to get novel information and data and get insights from other financial institutions (Alomari et al., 2020).

Technological assistance has been crucial for knowledge management in a banking organisation. When a business has a sophisticated IT infrastructure in place and is using it, knowledge management initiatives frequently succeed. The

knowledge management process is supported by various IT infrastructures, including decision support system, document management, email, workflow software, and data warehousing. Knowledge management can also include data warehousing, brain storming applications, group goods and workflow systems, information retrieval engines, document management systems, and intranets (Nurdin, 2016).

Prior to sharing, saving, using, and improving knowledge, Islamic FinTech organizations must include knowledge management within Islamic legal principles and norms. To create a solid organisational environment, information resources have been essential (Nurdin & Yusuf, 2020). The creation of a solid organisational environment, however, depends heavily on knowledge resources. Management and organisations, however, are challenged with the challenge of navigating the information sea as knowledge and information grow and become more and more accessible via the internet. In the current banking industry, knowledge management systems have been the essential instrument. It has been crucial to stress the necessity of integrating knowledge management systems with competencies and resources if firms are to gain a sustainable competitive benefit. The development and maintenance of a sustainable competitive advantage through the innovation of products and processes requires both of these factors. Learning and resource development processes should be facilitated and updated by knowledge management systems in order to transform learning skills and core competencies into sustainable excellence (Bakar & Hashim, 2011).

4.5 Sustainable aspects of Islamic FinTech

A commitment to environmental, social, and governance (ESG) initiatives has governed Islamic FinTech firms in their conduct as well as shaped their services. The use of sustainable investment and green financing has become more prevalent in Islamic nations (Ismail & Shaikh, 2017). Capital conversion must be promoted in sustainable ways to protect future generations, which will be reflected in the environmental determinants of capital conversion (Al Breiki & Nobanee, 2019).

A focus on integration of social determinants has also influenced Islamic FinTech, with investments made for promoting conflict and crisis management, facilitating access to healthcare, creating employment opportunities and maintaining and promoting education. Islamic FinTech has created management

audits in terms of governance initiative to measure performance based on social impact rather than profits alone. The development of new ideas and methods that are required to direct investments towards sustainable initiatives are made possible by Islamic digital economic system. The sustainable investment possibilities can be offered by using techniques like artificial intelligence, big data analytics, and similar. Moreover, the UN Sustainable Development Goals are becoming more widely known, and FinTech companies are capitalising on this awareness by articulating them in ways that are compatible with the financial and contextual requirements of Islam (Ismail & Shaikh, 2017).

5 Conclusions

This study studies the qualitative data on shaping factors and perspectives of the Islamic nations by considering Fintech, Cryptocurrency and Entrepreneurship. The innovation and adoption are considered to have a positive impact on the financial services of the Gulf Islamic nations. The shaping prospects of cryptocurrency, fintech and entrepreneurship are extremely important in the Islamic world. There are efficient fintech opportunities currently processing in the development of Islamic finance. The Fintech technologies are directly related to the entrepreneurship programs that enhance the economic growth. In comparison to conventional banking and finance, Fintech technologies are much more cost-effective in banking (Lestari et al., 2020). Considering the Islamic Fintech, Cryptocurrency and Blockchain technology provide an innovative and a secure way of performing effective transactions. The Blockchain transactions are visible and transparent to every customer. Sharia Law compliance partially allows cryptocurrency regulation. The regulated cryptocurrency is accepted in all Islamic countries. In the future years, the importance and evolution of Islamic entrepreneurship will expand. Islamic entrepreneurship has received excellent feedback from business practitioners, researchers, entrepreneurs, governments, and academics.

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Exploring Learning Spaces for Innovation Capacity: A Multiple Case Study

Rosaria Lagrutta*

Department of European and Mediterranean Cultures
University of Basilicata
Via Lanera, 75100 Matera - Italy

Daniela Carlucci

Department of European and Mediterranean Cultures
University of Basilicata
Via Lanera, 75100 Matera - Italy

Giovanni Schiuma

Department of Management, Finance and Technology
LUM University Giuseppe Degennaro
S.S. 100 km 18 – 70010 Casamassima (Bari) – Italy

Francesco Santarsiero

Department of Matematics, Computer Science and Economics
University of Basilicata
Via dell'Ateneo Lucano, 10, 85100, Potenza - Italy

Antonio Lerro

Department of Matematics, Computer Science and Economics
University of Basilicata
Via dell'Ateneo Lucano, 10, 85100, Potenza - Italy

** Corresponding author*

Abstract

Innovation capacity is considered a distinctive driver, for organizations, to face the challenges of the current, increasingly complex, scenario. In such perspective, several researchers emphasized the importance of learning orientation, knowledge sharing, and learning environment as key determinants of innovation capacity. In this vein, developing learning spaces and learning environment fostering knowledge and learning dynamics, become a key objective of public and private organizations.

In this prospect, this study aims to provide a comprehensive and holistic view of the distinguishing dimensions of a learning spaces, enriching the findings emerged from the literature review that, through the lens of a conceptual descriptive framework, identify dimensions and features that characterize effective learning spaces supporting the development of innovative capacity. The research is carried out through a multiple case study, involving learning spaces designed and developed in Finland. The findings provide an integrative picture of a descriptive conceptual framework that supports the identification of the relevant dimensions to manage and evaluate. Specifically, in terms of theoretical implications, it aims to guarantee and enhance the effectiveness of a learning space supporting the development of more effective and impactful guidelines for management and decision-making. Then, in terms of managerial and policy implications, the analysis of the conceptual model developed and discussed can be helpful to different actors aimed at developing effective learning spaces to foster innovation capacity of public and private organizations.

Keywords – Learning space, technology, knowledge-management, innovation capacity.

Paper type – Academic Research Paper

1 Introduction

Nowadays, public and private organizations appear increasingly committed to fostering skills necessary to deal with the challenges of the current scenario by enhancing their learning capacity. The current scenario is increasingly complex and characterized by uncertainty and volatility, therefore, organizations need to develop innovation capacity, considered a key driver for survival, competitiveness, and long-term growth and success. (Hamidi et al., 2019)

The innovation capacity is influenced by a range of factors and most of the factors are related to the processes of learning and knowledge. In fact, for an organization, learning and knowledge processes and dynamics represent the engine for the development of the capabilities for sustainability in the new business age. (Nonaka and Takeuchi, 2019; Hamidi et al., 2019)

In such perspective, several researchers emphasized the importance of learning orientation, knowledge sharing, and learning environment as key determinants of innovation capacity. (Yildiz et al., 2021)

A learning environment or learning space refers to the physical, virtual, social, and cultural context in which learning takes place. In this vein, according to the literature, new spaces to foster innovation and boost learning and knowledge dynamics are acquiring increasing importance, becoming key objectives for public

and private organizations. (Yildiz et al., 2021; Morris, 2020; Hamidi et al., 2019) The literature suggests that learning spaces are places where knowledge is created, shared, and applied; they may be described as spaces of interaction between individuals, their behaviors, and the external environment.

Different factors influenced the evolution of the learning spaces, specifically, the reorganization of spaces oriented towards the learners and the learning process, gives emphasis to the diffusion of LS supported by innovative and digital tools. (Karam et al., 2021).

The pandemic has altered the landscape and forced spaces supporting knowledge and learning dynamics to quickly evolve to meet new unexpected challenges and to fully exploit digital technology for training purposes. (Karam et al., 2021; Krishnamurthy, 2020). Therefore, LS are integrating strong technological components, to enhance the learning process and knowledge dynamics.

Despite their growing importance, the literature is fragmented and there is a gap concerning a comprehensive and holistic view of the distinguishing dimensions of the learning spaces. (Csizmadia et al., 2022).

In this prospect, this study aims to enrich the findings from the literature review that, through the lens of a conceptual descriptive framework, identify dimensions and features that characterize effective learning spaces supporting the development of innovative capacity.

The research is carried out through a multiple case study, involving learning spaces designed and developed in Finland, aimed at answering the research question (RQ): "What are the dimensions of a learning space?". The study aims to provide an integrative picture of a descriptive conceptual framework that supports the identification of the relevant dimensions to manage and evaluate. Specifically, it aims to guarantee and enhance the effectiveness of a learning space.

The paper is organized as follows. In the next section, the conceptual framework derived from the literature review is presented and the dimensions of a learning space are briefly pointed out. Then, the theoretical data are triangulated with evidence gathered from the case studies analysis. Finally, theoretical and practical implications and future research directions are illustrated.

2 Conceptual framework: the learning space infrastructure

Spaces supporting learning and knowledge dynamics, to boost organizations' innovative capacity are acquiring growing importance in public and private organizations but, despite this, the literature does not provide a comprehensive and holistic view of the distinguishing dimensions of these spaces. (Csizmadia et al., 2022). In this study, the analysis was developed according to a multidimensional approach (see Figure 1), which starts from the dimensions of a learning space derived from the literature review and then enrich and strengthen the conceptual model proposed.

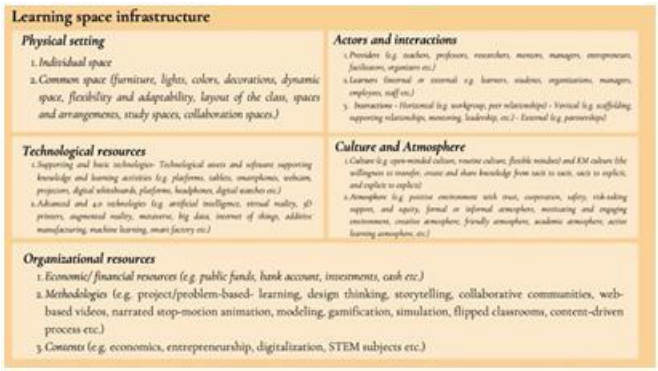

Fig. 1. Conceptual model - learning space infrastructure

2.1 Infrastructure of a learning space

Learning spaces enable and catalyze knowledge and learning dynamics, supported by a tangible and intangible infrastructure that fosters open, honest, and receptive interactions among the actors involved. (Delgado et al, 2020) In the following, the infrastructural dimensions of a learning space are briefly described.

2.2 Physical setting

The physical setting of a learning space includes individual and common spaces. Scholars have discussed some key characteristics of such spaces which are furniture, seating arrangements, lighting, temperature, decorations, and acoustics. (Sasson et al, 2021)

2.3 Technological resources

The technological resources dimension contemplates a combination of technological tools that can foster or prevent impacts on the learning processes. In consequence, the design and management of a learning space must be associated with the choice of the appropriate tool to use, to exploit their potential and maximize the value added. (Delgado et al, 2020)

The literature discussed the use of various technological tools; in particular supporting and basic tools and advanced and 4.0 technologies. Examples of basic technological assets and software are platforms, computers, mobile phones, tablets, projectors, headphones, digital whiteboards, and so on. (Latrous & Khadraoui, 2020) Concerning advanced 4.0 technologies, some representative examples are Artificial intelligence, Internet of Things (IoT), augmented and immersive reality, digital platforms, metaverse, sensors, algorithms, adaptive learning platforms, and other smart technologies, that facilitate interaction and collaboration in the learning process. (Abdalina et al., 2022; Diaz Tito et al., 2021)

2.4 Organizational resources

This dimension includes methodologies, contents, materials, and resources available to support learning. Some examples of methodologies may be project/problem-based learning, design thinking, storytelling, collaborative communities, web-based videos, narrated stop-motion animation, modeling, gamification, simulation, flipped classrooms, content-driven processes etc. (Filippou et al., 2018; Maheshwari & Seth, 2019)

Schobel & Scholey, (2012) identify other important organizational resources that are economic resources and specifically the financial strategies adopted.

2.5 Actors and interactions

The success of a learning space strongly depends upon the actors, how they are engaged within the facility, and how they interact with each other.

According to the literature, two types of knowledge actors can be identified in a learning space: providers of knowledge and learners. Learners can be an internal or external target, some examples are students, managers, organizations, employees, and staff. On the other hand, providers are people supporting learners, acting as coordinators who facilitate the interactions and the exchange

and development of knowledge. (Stern et al, 2020; Pawlowsky et al, 2020; Nonaka and Takeuchi, 2019; Sankari et al, 2018)

The interactions include the system of relationships between internal and external actors that take place in the learning environment. According to the literature, the design of the learning space has to promote positive relationships and a sense of belonging. (Abuhassna et al., 2022) The interactions can be horizontal, vertical, and external. In a physical setting, interactions may occur through face-to-face discussions and group work, whilst in an online learning environment, interactions may occur through discussion forums, video conferencing, and other digital communication tools.

2.6 Culture and atmosphere

This dimension identifies the mood, attitudes, expectations, practices, norms, and sensorial qualities distinguishing a learning space. It influences the effectiveness of the space, increasing or preventing motivation, attention, creativity, and the level of involvement of people. A positive learning environment promotes open-minded culture, flexibility, and willingness to engage in innovative activities and knowledge culture drives and encourages coding, transfer, and application of knowledge, to promote learning and innovation. (Abuhassna et al., 2022; Csizmadia et al., 2022; Karkoulian et al., 2013)

3 Methodology

From a methodological point of view, according to the aim of the study, a multiple case study approach (Yin, 2009) has been rigorously elaborated and developed to provide empirical insights supporting the evidence emerging from the above proposed conceptual model.

Generally, a qualitative management research allows to capture intangible factors that create higher value for the literature. Furthermore, according to Yin (2009; 2013), the conducted case studies aim to gather valuable insights, through literal replication of real-life situations and allow cross-comparisons between different realities by identifying and defining critical learning points related to the fields of analysis that will result in helpful empirical guidelines for both scholars and practitioners.

In order to develop the study, an extensive documentary research and in-depth interviews were carried out with the leaders of each LS. All the interviews were

recorded and transcribed. This allowed to have a reliable information base that perfectly reflected the interviewees' thoughts.

4 Cases analysis and findings

To better empirically investigate the field of learning spaces, enriching and strengthening the conceptual model proposed (see Fig.1), the study involved four learning spaces developed and managed in Tampere, Finland. They are *Tx*, *Hx*, *Dx* and *Kx*. The names have been changed for confidentiality reasons.

The rich body of data collected was fundamental to cross-compare the different realities and to explore in-depth the processes and the dimensions characterizing real learning spaces.

Table 1 provides a short description of the 4 learning spaces under analysis.

Table 1 – Mission of the learning spaces under analysis

Tx	Tx (City of Tampere) is a community space, a unique place in Finland. They are an open community for people that want to sell their ideas and find interesting partners. The aim of the space is to unite actors dedicated to serve Tampere startup and entrepreneurial ecosystem such as individuals, industries, entrepreneurs and companies.
Hx	Hx is a learning space situated within the university of Tampere. It offers the opportunity to expand entrepreneurial expertise and find solutions to the real-life challenges of an organisation by creating teams of students who have different backgrounds. Their approach encourages experimentation and stimulates an open mindset and innovation skills. Hx is a unit of entrepreneurship, they offer studies on entrepreneurship and sustainable entrepreneurship.
Dx	Dx is the leading co-creation learning space that aims to boost transformative and innovative dynamics in Finland and beyond. It is an innovation platform bringing together professionals, organizations, shareholders, researchers and co-creation facilitators. Dx's role is to help companies resolve challenges related to high-risk research activities, disruptive business transformation, and capability development needs by offering focused co-creation services. The most important purpose is the vision about the future. They aim to make people agree on a shared vision of how the future will be or should be. And then they develop a roadmap, highlighting how everybody will benefit from the results achieved.
Kx	Kx is a learning space that offers its members selected services to support collaboration and networking. It provides several facilities around three campuses and access to an international scientific community and talent pool. For companies, membership provides an opportunity to build brand visibility and strengthen their employer image at Tampere Universities community.

Several reasons motivated the choice of the case studies as a convenient sample:

1. despite the different specific aims of each LS, their general mission is to enhance and stimulate the innovation capacity of the actors and organizations involved as well as the whole city and region, as a source of growth and wellbeing;
2. the programs have been held with the cooperation of the academic context and the local ecosystem, and therefore they represent excellent contexts to apply and validate all the items of the proposed framework;
3. the existence of a significant amount of data and the direct involvement of the authors provided a unique opportunity to dig deeper into understanding.

In consequence, the analysis of the 4 learning spaces offers an articulated and rich picture of their dimensions. In the following, the main findings from the joint examination of the case studies are described.

Validity and reliability were secured by following the guidelines proposed by Yin (2009). In particular, multiple methods (document analysis, and in-depth interviews) were adopted to investigate the phenomena and collect data allowing construct validity. Moreover, validity was also increased by the choice of using a multiple case study approach, with cases developed in an international context. On the other hand, reliability can be demonstrated by storing of all the data collected and recorded.

In the following, each of the dimensions identified with the conceptual framework is enriched with the results derived from the joint analysis of the case studies.

4.1 Physical setting

The learning spaces involved in the analysis are developed within the Tampere University campuses and in similar knowledge repositories, such as accelerators, incubators, collaborative platforms and labs. The different cases have distinct features, but the key common characteristics are flexibility and friendly and informal space.

Two learning spaces own more places within the Tampere University campuses, whilst the other two are developed in a single place.

Regarding the setting, the LSs are built as open community spaces or co-working spaces. Those kinds of settings are relaxed meeting spots, for example, for team meetings, for naps and relaxation or for stimulating creativity and learning. There are sofas and easy chairs situated in a flexible and colored setting, with decorations, lighting and moveable chairs and furniture to create an informal atmosphere.

From the joint analysis of the case studies, the components derived, characterizing individual and common spaces, are:

1. flexible furniture (e.g. moveable chairs, desks and tables);
2. gym equipment;
3. kitchen space (e.g. coffee machines, microwave, dining table);
4. relax space (e.g. sofa, easy chairs, television);
5. common networking spaces (e.g. desks for teamwork, post-its, memo board, blackboard);
6. stage

4.2 Technological resources

The cases under analysis use different digital technologies, mostly to allow a hybrid or virtual approach. Concerning more advanced tools, that may enrich the learning processes and knowledge dynamics, two leaders stated that they actually employ them for some specific lectures or projects in cooperation with specialized labs.

According to the results of the analysis, the technology may help achieve the LSs' objectives but nowadays their potential is not fully exploited, despite the pandemic fostered their use and demonstrating that situations can evolve really fast. Before Covid-19 people did not use technologies as much as they do now, they needed time to learn and to overcome routine habits.

Examples of basic technological tools employed in the learning spaces under analysis are:

1. screens and digital whiteboards for in-events and lecturers;
2. virtual platforms for distance meetings and lectures;
3. digital boxes to enhance collaboration and creativity;
4. app and software used to support relationships building.

Concerning more advanced tools, from the interviews it emerged the use of methods and tools, such as AI and virtual reality, to make pilots, mockups, proof

of concepts and demos in a fast and simple way. Moreover, it has been highlighted the importance of big data, machine learning and autonomous technologies. Technologies need data that come from digital platforms and spaces. Making the customers willing to share their data and knowledge is fundamental to identifying new opportunities and benefits from existing data achieved.

Another topic derived from the analysis of the interview is the use of computing solutions to improve cyber security or reduce CO2 emissions. For example, manufacturing 3D printers and big data emerged as key tools to reduce CO2 emissions.

According to the leaders, a method to train people within a learning space and make them willing to use and employ digital technologies is to make their potential clear, diffusing information about best practices and effective outcome examples achieved thanks to the technologies implementation.

One of the leaders interviewed stated that, in its learning space, they are trying to build their own platform, suiting the needs of heterogeneous participants, whilst the others leaders are planning to implement advanced technologies in the near future. These efforts need energy and resources but, most of all, they need a change of habits. In Finland, they can effortlessly access effective and innovative devices and technologies that are easy to use, but they need strong training and culture, which emerged as the most influencing factors, according to the analysis of the interviews.

4.3 Organizational resources

From the joint analysis of the case studies it emerges that the leaders of the learning spaces, to reach their aims, proposed several methodologies and ways to support the development of competencies and innovation capacity through learning and knowledge dynamics. Specifically, it emerged the proposal of different kinds of programs, arranged remotely or physically:

1. Seminars and support sessions for people involved within the space;
2. Group coaching programs;
3. Matchmaking events;
4. Networking events;
5. Innovation Challenges;
6. Brainstorming, seminars and workshops;

7. Innovation Festivals;
8. Intensive courses, with video, links and lessons;
9. learning by doing and learning by developing;
10. discussion forums;
11. gamification that is becoming more and more typical because young people entering the working life are comfortable with digital games.

Generally, from the interviews it emerged a willingness to use methodologies that guide learners toward a certain aim, questioning them, show them the ways to work. It has been highlighted the need to adopt different learning approaches, stimulating different kinds of learning experiences, because traditional learning alone is not enough anymore. To meet learners' needs, most of them propose different kinds of methodologies, chosen for individual learners and teams on a case-by-case basis, by coaches and mentors.

Concerning the economic and financial resources, all the leaders claimed the importance of choosing the right financing methods to enhance the effectiveness of the space and decide in what dimensions invest more. Hx and Kx developed the spaces within the University of Tampere, which are financed by public funds, while the other two participate in public tender notices.

4.4 Actors and interactions

People operating within and outside the learning spaces have a key importance for the effectiveness of the space. Each of the spaces under analysis has a heterogeneous group of actors involved as learners or knowledge providers.

From the analysis of the results, the learners involved are:

1. students (at different educational levels);
2. individuals on their startup journey;
3. people from companies, mostly employees, managers and entrepreneurs.

Generally, target groups are from different kinds of companies, from global multinational companies to small startups.

On the other hand, different knowledge providers are included, such as:

4. mentors and facilitators;
5. top managers;
6. experts;
7. researchers;

8. professors.

Researchers, professors and academic institutions are integrated also with the aim to share knowledge and ideas and understand if they have a shared vision about the future and how to cooperate, optimizing activities and resources.

Moreover, they also have operational teams consisting of active people, who work together on a daily basis to maintain and develop their activities and services. Some examples are the board, volunteers, fellows, partners and collaborators.

The main idea that emerged is to integrate all the actors involved and work together to reach common aims.

The missions of the learning spaces under analysis are developed around the concepts of network, cooperation and community. Specifically, two of them serve the entire Tampere startup ecosystem by uniting startups, driving individuals and organizations to take action and building a thriving startup community.

Knowledge transformation and sharing are favored and encouraged in all the cases under analysis, with internal and external trustful relationships that the participants cultivate to collect social capital. Internal continuous and open interaction relationships are facilitated and encouraged by coaches and mentors as well as the development of trust and reflection in learning and project teams.

On-site and virtual events and team working activities are organized to strengthen internal interactions, human contacts, interactions and exchange of knowledge. In this perspective, relationships, team, building and team skills are developed through collegiality and a relaxed and friendly atmosphere.

On the other hand, external interactions are favored by authentic experiences with companies, the use of team agreement and seminars about group learning (e.g. principles of dialogue, tasks of a learning team, three-layered learning, significance of trust in teamwork etc.). Different institutional actors cooperate with the learning spaces under analysis, such as Tampere startups or the city of Tampere. They all want to strengthen these external relationships, also from an international perspective, to build a stronger innovation ecosystem.

4.5 Culture and atmosphere

The cultural dimension is considered the most important one by all the leaders involved in the interviews. In their opinion, culture shapes almost every decision, what value to achieve, which tool to use, what kind of program to implement, and

how to develop social values and be more open. Motivation and flexibility are the key characteristics highlighted by the results obtained from the interviews. Despite this, developing this kind of culture and atmosphere is not always easy because people are motivated by different factors. Understanding what people desire and selling them exactly what they want is the way to keep a motivating atmosphere.

Moreover, in their opinion, the most important competence is the ability and willingness to share and transform knowledge.

Concerning the atmosphere of the learning spaces, according to the leaders, a friendly and informal climate may help people express their opinions and feelings.

5 Conclusions

This paper has analyzed the learning spaces' dimensions in a structured and holistic manner. From a review of the literature, five infrastructural dimensions of a learning space have been derived, in particular: i) physical setting; ii) technological resources; iii) organizational resources; iv) actors and interactions; v) culture and atmosphere. The findings derived from the practical application supported and enriched the theoretical assumptions.

In particular, the findings derived from the case studies proved the usefulness of the conceptual framework in supporting learning spaces' leaders and other stakeholders in identifying and categorizing the critical dimensions and their interdependence, fostering the definition of strategies for improving the effectiveness of the space. Moreover, from the interviews, it emerged the high importance given to the actor and interactions dimension. In fact, it has been proven that fostering high-quality relationships means facilitating knowledge exchange, transfer and creation and, in consequence, innovation capacity.

The research provides both theoretical and practical implications. In terms of theoretical implications, the paper provides a conceptual framework capable of fostering a specific research stream and carrying out a first holistic perspective of the dimensions of learning space to develop more effective and impactful guidelines for management and decision-making and to support the assessment and the improvement of the specific spaces.

On the other hand, in terms of managerial and policy implications, the analysis of the conceptual model developed and discussed can be helpful to different

actors aimed at developing effective learning spaces to foster the innovation capacity of public and private organizations.

The main limitations of the study reside in the lack of a deep analysis of the impacts generated from the learning space, in terms of short and long-run outcomes and in the limited sample under investigation. The limitations represent opportunities for future research in order to reinforce the conceptual framework, the findings' generalizability as well as to collect more pieces of evidence and further rigorous and valid insights to derive guidelines from managing and assessing effective learning spaces for innovation capacity.

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Manage Integrated Social Health for a Sustainable Home Care Model

Stefania Mele*

Unitelma Sapienza University
Piazza Sassari 4 - 00161 Roma

Sabrina Bonomi

eCampus University
via Isimbardi, 10 – 22060 Novedrate (CO)

Concetta Lucia Cristofaro

eCampus University
via Isimbardi, 10 – 22060 Novedrate (CO)

* *Corresponding author*

Abstract

Covid 19 has increased the need to integrate the service chain by imposing transformation processes on healthcare organizations, challenged by the complexity of the demand for health and the evolution of the service chain (public and accredited private). This process increases the need for integration between parts of the health system, such as the social-health district. Alongside the need for integration, "navigability" is developing between operators and users, especially among chronic population targets with greater socio-medical complexity. All this determines a growing demand for connection which sees in the care models in transition a new form of job specialization that requires new role profiles, relationship skills and dialogue between operators, operational management tools relating to the service chain of territorial services, specific information collection, and management systems. In this context, change is activated by Knowledge Management (KM).

Keywords – social-health care, relationship, home care, change, and knowledge management.

1 Introduction

The KM represents the application of the change management approach model to support change processes through the exchange of experiences and the dissemination of knowledge results, but also the comparison with benchmarking systems capable of stimulating professionals through the comparison with experiences that lead to positive emulation. KM assumes the task of promoting and developing, with adequate training, incentive, and communication tools, the ability to learn within the organization, generating a culture open to continuous comparison, measurement, and discussion of results (Havens & Knapp, 1999, Du Plessis, 2005). The processes of change are based on the exchange of experiences, on the dissemination of results and knowledge between internal/external administrations to the system, which often activates, according to participatory logic, intense interactions creating networks, partnerships, and networks (from legislation to knowledge management).

This contribution aims to analyze the relationships between the actors of the regional governance system to observe their different governance models in the national context, compare the home care systems, and define the possible processes of change, through the exchange of knowledge, with the introduction of ICT in home care processes. More specifically, the study observes how the integrated social-health management of chronicity through ICT tools is to implement an effective, integrated, and sustainable home care model for the chronic user hospitalized for one or more high-impact chronic diseases (e.g., diabetes, COPD).

The common opinion is that healthcare reorganization passes through the territorial network's reorganization.

In our country, the path of decentralization of taking care of patients from the hospital to the territory is realized with the implementation of a homogeneous and easily accessible territorial network; as of today, still incomplete and fragmented, despite being a process that started many years ago. This evolution implies the need to reorganize and strengthen the activities of the territory or those related to primary care not only at a regulatory level but also at an operational level, with the implementation of new organizational models and the use of ICT.

Strengthening the territorial network means creating a health system closer to the population, characterized by a greater capillarity, adhering to a model of

proactive taking charge, both in the interventions of prevention as well as diagnosis and treatment, and from the integration and continuity of assistance in the various settings in the context of emergency. What matters most is the supervision of the territory and the taking charge of the single person and of the communities, also including the "hard-to-reach" and "invisible" (hidden population) groups, for reasons related to the sometimes the social and economic situation in which they find themselves living. So, one of the biggest challenges will be combining health with social.

After a literature review, the explorative case study is presented, and then the authors' conclusion.

2 Theoretical framework

Healthcare is going through profound changes, and ICT is a strategic asset and essential for the success of healthcare organizations in turbulent, dynamic, and complex environments. ICTs are a necessary strategic resource for the success of healthcare organizations in the new socio-economic scenario. Especially for the public health sector, there must be more room for combined organizational and technological innovation. Due to the characteristics of the processes and the service offered by the healthcare sector, ICT could help to achieve wide margins of effectiveness.

The social-health sector is undergoing a process of change; the increasingly rapid and continuous development of applied technologies and the growing acquisition in the scientific field makes it possible to reach, particularly in medicine, levels of diagnostic and therapeutic accuracy hitherto unthinkable and to treat pathologies previously considered incurable and thus the average life span lengthens. However, at the same time, social ties fragment, disposable income decreases, and parental solidarity is reduced; many people, especially older people, and chronic diseases, find themselves increasingly alone and needing care. Therefore, health promotion cannot disregard relationship paths in which it appears essential that, alongside technical-professional skills, we know how to listen to needs by reading them correctly and formulate a network of listening and sharing, which allows combining the humanization of care with high technology, specialization, and scientific expertise. (Bonomi, 2019).

Social involvement in healthcare systems means interventions in which the community is involved to achieve health objectives that can be organized with

different approaches, depending on the characteristics of each intervention and on the other degree of community involvement: technological innovation, social innovation, knowledge sharing may depend on the scope of the public administration and all healthcare ecosystems. The main strands identified in the literature can be summarised as community participation, community development, community empowerment, community-centered approaches, community building, community organizing, community-based initiatives, and community engagement (Longo & Barsanti, 2021).

Community engagement is a generic term encompassing a continuum of approaches to engage local communities and interest in improving population health and reducing health inequalities (Popay et al., 2007). This process of participation and involvement facilitates the inclusion of several other actors into the co-creation chain of the value of the health service: caregivers, social care systems, and reference communities (disease-specific associations) and the acquisition of new practices that can then be transformed into protocols (Botti & Monda, 2020). Value co-creation among service participants includes external stakeholders as another piece of the co-creation process. One could talk about distributed management, given that a new managerial path is defined between the actors of the care process and the management process (Lo Presti et al., 2019). In the evolution of the healthcare ecosystem, caregivers become ever-more part of the healthcare facility community, changing the relationship between internal (doctors, nurses, patients) and external (caregivers, caregiver associations, patient associations) stakeholders in the hospital (Spagnoletti et al., 2015).

To understand and explain the type of relationship that exists between an organization and its stakeholders, the concept of involvement plays a role close to that of "corporate social responsibility" and "long-term sustainability" of the health service (Testa et al., 2017; Aldossary, 2017). From an even broader perspective, one can speak of sustainable health service development where stakeholder involvement mediates conflicts arising from differing expectations (Pereno et al., 2020).

3 Methodology

An empirical analysis, a qualitative investigation conducted based on exploratory research, was used in this work to investigate a problem that needs to be clearly defined.

For such research, we started with a general idea and used this research to identify issues that may be the focus of future research. The problem is at an early stage. A qualitative research approach is the most suited to handle this type of inquiry because this study revolves around a 'how' question and because the scientific research in this field in addressing healthcare challenges is still in its infancy (Edmondson et al., 1994).

The first phase focused on the model by collecting and analyzing material and organizational documents. For literary research, sources may include newspapers, magazines, books, government agency documents, topic-specific articles, literature, and annual reports. The second phase is the evaluation carried out following the execution of surveys, about 40 minutes each, that collect information from a predefined group of interviewees on the governance model of the region. Among those interviewed were the Board of Directors, the Management (General Manager, Administrative Director, and Health Director), and the Managers of the ASL concerned.

The annual financial statements and the financial results were also studied together with the governance and regulation mechanisms of the main welfare processes: procedures, manuals, regulations, certifications, information systems, accounting systems, governance (by-laws and corporate agreements), management reports, service, organizational models, etc. In the last phase, the study of the collected data and the semi-structured interviews have pros ducted a final evaluation report on the various territorial government models.

As researchers examine the collected data, ideas or concepts become apparent to them researchers. These ideas/concepts are said to “emerge” from the data.

These categories can become the basis of a hypothesis or a new theory.

From this perspective, the work is to help provide a public health sector focus not only on ICT as a production technology tool but also as a technology organization.

4 Integrating social health and sustainable home care model: the case "Initiative medicine," state of the art.

It is called "Initiative medicine," a new approach that "goes to meet" the citizen before the pathologies arise or worsen. It has been designed to respond effectively to the aging population trend. It aims to the prevention and improvement of the management of chronic diseases at all stages and concerns all levels of the health system. As opposed to waiting for medicine, which works on demand on a single citizen, initiative medicine studies ex ante the aggregate data of the population to identify target citizens to call and engage proactively. Scientific evidence points to the importance of reorienting health care and policies towards chronicity that sees a central role of primary care systems, not only reactive to punctual requests for assistance but able to anticipate, and stratify the individual condition in the wake of the natural history of the disease, the specific needs of the subject, plan care pathways, and address the chronic patient in an individualized way, thus building a person-centered system of care. These principles are reaffirmed in the Italian PNC (Plan for National Chronicity), which, linking up with the National Prevention Plan, provides, for the fight against chronicity problems, a combined and integrated approach between community strategies (oriented towards health promotion, intersectoral and by setting), and strategies aimed at the individual (prevention and early diagnosis).

Initiative medicine requires the inclusion of three additional functions/processes in each area of the NHS:

- the aggregate study of big data by groups of patients (determinants, consumption, adhesions, outcomes, etc.) to select the targets to solicit;
- proactive recruitment and, therefore, direct communication to citizens who have at least
- one needs potential but hasn't necessarily expressed a question yet;
- patient case management to accompany their fruition processes over time to support theirs adherence, check the results to possibly alert the appropriate service network node in the event of necessity (non-adherence or unexpected outcomes).

These three competencies and functions (local big data analytics, recruitment, and case management) must become the cultural heritage of all services and all professional components. Ideally, they should be based on digital and automated tools, capable of generating direct contact with the citizen if data analysis

identifies sentinel elements or exceeding thresholds considered risky to strengthen compliance or invite him to service. An information infrastructure is, therefore, the key to enabling access to stratification profiles of patients with MCNT and realizing the alert function, proactively detecting subjects at greater risk, planning the necessary clinical actions, and verifying that what has been undertaken is congruent with the evaluation indicators envisaged for pathologies.

The operation of some of these processes can be partially centralized and delegated to some specific settings or corporate roles. Still, the logic of initiative medicine must operate at an overall level. For example, a service corporate central can digitally monitor medication adherence and may also automatically report low levels of compliance directly to the citizen or his caregiver. Any subsequent, direct intervention must occur at a decentralized and capillary level by the service in charge of the patient (e.g., community nurse, contracted specialist, nurse, or hospital ward doctor). The Community Houses and the various intermediate care settings represent the privileged places for centralizing some functions of initiative medicine, both in the field of primary prevention (e.g., primary prevention of cardiovascular risk in a healthy population) and pathway management care of chronic or frail patients, incredibly if clinically not too complex. The information provided by predictive models would be very effective in aiding the design of intervention strategies based on the real needs of the user and his family/caregiver. For patients who are clinically very complex, the same logic should be implemented at a hospital specialist level, with the opportunity to refer the patient to the Community House closest to his home as a decentralized place of delivery. The starting point for outlining and activating a strategic change is sharing the need to change. Clarify and communicating the context, through the presentation and discussion of the reasons and objectives to "do," is in itself the most robust possible action to activate change, to the extent which provides all company players with the same "lens" through which to understand the priorities for action and the consequent organizational dynamics. Good corporate-level change management should, therefore, always start with a "narrative" that emphasizes the deeper reasons for the change proposed, as connected first of all to the corporate mission, to the production of "value," to mean "social," and only after the existence of institutional obligations or indications, which certainly can be binding, but must not enforce the change itself by way of fulfilment. The institutional framework is one "bank" on which the organization's management leans to build the framework within which to place

the building a sense of urgency and awareness of the need to change and innovate. But the whys cannot be derived only or mainly from the outside but rather be connected to the company's own ambitions same organization. In this perspective, the immense theory of organizational change can first be traced to a modelling that identifies three main stages through which to proceed:

1. the phase of becoming aware of the need and urgency to change and innovate, otherwise called "organizational unfreezing";
2. the exploration of alternatives to change and innovate, with the adoption of the path and contents specific to carry forward;
3. consolidating the change and the innovative state with actions to reinforce the new processes, identification of implementation responsibilities, and strengthening of routines that redefine the normality of work according to the new set-up/model.

5 Discussion and conclusion

The spread of telemedicine now involves the entire National Health System. Accelerators of this process have been the Covid- 19 emergency and the National Plan for Resistance and Resilience (PNRR) that emerged from Covid-19. The PNRR considers telemedicine to be one of the main drivers of innovation in the health service and a necessity to care for citizens suffering from chronic diseases and the elderly needing constant services. This plan aims to keep patients in-home care or home for as long as possible to avoid unnecessary hospitalization. The case analysis provided a broad context for the doctors' clinical evaluation and an analysis of the behaviour of patients, caregivers, and operators at the introduction of the service.

However, the results can be further expanded by repeating the survey after the consolidation of the service (the survey covered the first six months) and collecting patient testimonies to obtain other points of view. The case analyzed confirms the importance of patient engagement in accompanying the digital transformation in healthcare organizations to improve the effectiveness and efficiency of care. However, a complete analysis of internal and external stakeholders could also be appropriate to explain better the participation model of all actors in the service, such as patients, caregivers, hospital top management, and suppliers of telehealth devices. The use of telemedicine also reduces the need for hospitalization while simultaneously improving the health system's economic

management by creating autonomy in the practical management of pathologies. At the same time, building a shared engagement model to support this process is essential, which is found in the shift from patient to community engagement. It is no longer only patients but the whole community that makes the wealth of knowledge and information available to all those involved in the treatment process. The value of this phenomenon is that it embraces entire communities and overturns the care model, moving from the hospital to quasi-medical treatment facilities in the territory (Community Homes) or the homes of patients themselves. Finally, several factors motivate further telemedicine research. First, the world's population is aging, as well as the increasing need for e-health. There is a need to ensure the safety of the elderly and treat them in settings that integrate them into society rather than isolate them in chronic hospitals. Second, while the centrality of the patient in health care processes has allowed for personalized care, the centrality of communities means definitively opening up the health service towards socio-medical integration (health ecosystem). Placing the person at the center has given humanity to health services, and the community focuses on society as a whole and its health needs.

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Female Directors, Critical Mass and CSR: The Moderating Role of Family Ownership

Gaetano della Corte*

Department of Law and Economics of Productive Activities
Sapienza, University of Rome
Via del Castro Laurenziano, 9, 00161, Rome, Italy

Federica Ricci

Department of Law and Economics of Productive Activities
Sapienza, University of Rome
Via del Castro Laurenziano, 9, 00161, Rome, Italy

Sara Saggese

Department of Economics, Management, Institutions
University of Naples Federico II - Monte S. Angelo Campus
Via Cupa Nuova Cintia, 21, 80126 Naples, Italy

Fabrizia Sarto

Department of Economics, Management, Institutions
University of Naples Federico II - Monte S. Angelo Campus
Via Cupa Nuova Cintia, 21, 80126 Naples, Italy

Vincenzo Scafarto

Department of Human, Social and Health Sciences
University of Cassino and Southern Lazio
Viale dell'Università – Folcara, 03043, Cassino (FR), Italy

** Corresponding author*

Abstract

Using a sample of 76 Italian publicly listed firms for the year 2019, this paper investigates the association between the presence of a critical mass of women directors on the board and the firm's CSR performance. It also examines whether the family firm status moderates this association.

The OLS regression analysis shows that the presence of a critical mass of female directors positively influences the CSR performance. In addition, the empirical analysis shows that

the family firm status has a negative direct effect on CSR performance, but has a positive interaction effect with a female critical mass.
Overall, these findings support the conclusion that the effect of female directors on CSR performance is influenced by the family ownership structure. This finding contributes to both the literature on board gender diversity and to the literature on family firms by providing evidence on the role of family ownership as a contingency variable that positively moderates the effect of a critical mass of female directors on CSR performance.
With regard to practical implications, this research calls the attention of board nomination committees on the key role of appointing a critical mass of female directors for achieving a better CSR performance.

Keywords – Female directors, Critical mass, Family ownership, CSR performance

Paper type – Academic Research Paper

1 Introduction

In the last few decades, one of the most relevant developments that has materially impacted the strategic focus of firms is the increased commitment to environmental, social, and governance practices, often referred to as Corporate Social Responsibility (CSR). In this regard, companies have started to embrace more responsible capitalism by improving their non-financial performance and making a positive contribution to the community (Garcia-Sanchez et al., 2014; Helmig et al., 2016; Issa and Hanaysha, 2022).

From the scholarly standpoint, the commitment to CSR is rooted in the stakeholder theory, which suggests that firms should satisfy the needs of all stakeholders to maximize firm value (Parmar et al., 2010; Dodd et al., 2022). Indeed, research highlights that a greater attention to CSR can affect firm performance (Albuquerque et al., 2020; Awaysheh et al., 2020; Huang et al., 2020).

Although prior studies point out that a wide range of factors can contribute to increasing CSR outcomes, (Gillan et al., 2021), they overall suggest that a pivotal role is played by the board of directors (Rao and Tilt, 2016; Shatnawi et al., 2022). In fact, this governance body is responsible for monitoring managers' actions (Hillman and Dalziel, 2003; Saidat et al., 2019) and for providing advice on how to manage the challenges from the external environment (Pfeffer, 1972; Pfeffer and Salancik, 2003; Hillman et al., 2009). More specifically, the board of directors is in charge of setting corporate strategies (including CSR strategies), while monitoring

managers in order to satisfy the needs of different stakeholder groups (Adams et al., 2011; Jain and Zaman, 2020).

Thus far, the academic debate on the board-CSR relationship has mainly examined the influence of board composition in terms of independence, size, gender diversity, CEO duality and minority directors (Béji et al., 2021; Rouf and Hossan, 2021; Khoo et al., 2022; Amorelli and García-Sánchez, 2021; Voinea et al., 2022).

In particular, concerning the role of female directors (Gurol and Lagasio, 2023), the existing literature posits that there are significant differences between men and women that might have implications for CSR. It is argued that women are more likely to hold a positive view and more empathy toward stakeholders' expectations and sustainability (Birindelli et al., 2019; Samara et al., 2019), that they can reduce conflicts and increase cooperation, that they are more sensitive to social events (Eagly et al., 2003) and less keen to accept unethical behaviours (Loukil and Yousfi, 2016; Ho et al., 2015). Additionally, compared to men, women would be more sensitive to CSR issues not least because they consider CSR as a means to improve their reputation and thereby improve their position of power within the firm (Hyun et al., 2016; Amorelli and García-Sánchez, 2020).

However, the implications for CSR of having a critical mass of women on board is still at issue (De Masi et al., 2021). Research suggests that boards with a critical mass of at least three or more female directors can positively affect CSR, not only in terms of CSR disclosure (Fernandez-Feijoo et al., 2014; Cabeza-García et al., 2018) but also in terms of CSR outcomes (Post et al., 2011; Bear et al., 2010; Kassinis et al., 2016; Cambrea et al., 2023).

Aside the implications of the critical mass for CSR performance, it is also interesting to shed additional light on how this effect might differ depending on the firm's ownership structure, which has been suggested as a potential driver of the presence of female directors on the board (Saeed et al., 2016; Ben-Amar et al., 2013). This may be especially the case for family ownership because research has shown that gender diversity differently affects the CSR performance according to the family firm status (Gavana et al., 2023; Beji et al., 2021; Cruz et al., 2019; Veltri et al., 2021; Cordeiro et al., 2020). However, the existing studies have not provided conclusive results, nor have they assessed the specific impact of a female critical mass.

Therefore, this paper not only focuses on the relation between a critical mass of female directors and CSR performance, but it also analyses whether the family firm status has a moderating role on this relation.

This research uses a sample of 76 Italian publicly listed companies for the year 2019. To test our hypotheses, we perform an OLS regression approximating the firm's CSR performance with the environmental, social and governance (ESG) score provided by the Refinitiv Eikon database. This score is a percentile rank scoring, which integrates information on the environmental, social and corporate governance dimensions of firm performance (Ricci et al., 2020).

The empirical findings show that the presence of a critical mass of female directors positively influences the CSR performance. In addition, results show that the family firm status has a negative direct effect on CSR performance, but has a positive interaction effect with a female critical mass. Overall, these findings support the conclusion that the effect of female directors on CSR performance is influenced by the family ownership structure.

Our study has scholarly and practical implications. From a theoretical standpoint, it advances the debate on the effects of female directors for firm outcomes by enriching the existing empirical evidence on CSR performance. At the same time, it enriches the research on the determinants of the ESG rating as a proxy measure for CSR performance. In addition, by investigating the moderating role of family ownership, the study takes a step forward in our understanding of the conditions under which this governance mechanism influences the firm's CSR performance. In terms of practical implications, this research calls the attention of board nomination committees on the key role of female directors as a critical mass in enhancing the CSR performance.

2 Literature review and hypotheses development

Scholars argue that women on board are more sensitive to CSR issues and are characterized by a strong commitment to CSR practices (Cook and Glass, 2018) for a number of reasons (Rao and Tilt, 2016; Bear et al., 2010; Hyun et al., 2016). Some studies suggest that female directors own extensive expertise in soft-related issues such as CSR (Zelechowski and Bilimoria, 2003). Other research highlights that women top managers are particularly cautious of CSR as they are characterized by both professional and reputational motivations that lead them to pay strong attention to such matters (Hyun et al., 2016; Velte, 2016; Fahad and

Rahman, 2020). Indeed, following the gender socialization approach, research claims that, while men have a more competitive attitude, women leaders own more ethical behaviour (Ryan and Haslam, 2007; Boulouta, 2013) due to differences in the social expectations and career path (Cook and Glass, 2018; Mavin and Grandy, 2016). Empirical studies show that the appointment of female directors has positive implications for CSR outcomes. For example, Galbreath (2016) and Hafsi and Turgut (2013) find that women on board positively affect CSR outcomes. Similarly, Zhang et al. (2013) and Byron and Post (2016) document that gender diversity due to the presence of female directors improves the firm's social performance. Besides, also Bear et al. (2010) highlight that the CSR ratings are positively associated with an increase in the numerousness of female directors.

However, it is worth noting that it is the presence of a critical mass of women on the board rather than the mere appointment of female directors that matters for CSR performance. In this regard, scholars emphasize that the contribution that female directors can provide to board decisions can be limited when they act as minorities and "out-group" board members (Bunderson and Sutcliffe, 2002; Lückerath-Rovers, 2013). Indeed, literature suggests that the appointment of women on the board as 'tokens' limits their ability to exchange ideas and opinions and hampers their input to decision-making, as they tend to face resistance by the majority group members (Cook and Glass, 2018). Conversely, having a critical mass of female directors improves their influence on company decisions (Torchia et al., 2011). According to the critical mass theory (Kanter, 1977a, b), when women directors reach a certain threshold (i.e., at least three), not only can better cooperate with the majority group members (Bear et al., 2010; Cook and Glass, 2018) but they can also affect the decisions of the overall group. Thus, when there is a female critical mass on the board, female directors can better express and protect their opinions (Arena et al., 2015), thus offering a meaningful contribution to the board discussion (Adams and Kirchaier, 2013; Schwartz-Ziv, 2017).

On the backdrop of these arguments, research shows that boards with a critical mass of female members results in better CSR. Indeed, some studies find that the presence of a critical mass of at least three female directors increases the CSR disclosure (Fernandez-Feijoo et al., 2014; Cabeza-García et al., 2018). Similar conclusions can apply to CSR outcomes. Bear et al. (2010) report that having a critical mass of women on the board improves the CSR ratings of the world's

most admired companies. Post et al. (2011) document that having three or more female directors on the board improves the environmental strength score of electronic and chemical companies in the US. Similarly, Kassinis et al. (2016) show that more gender diverse boards lead to greater environmental sustainability in US publicly listed companies. In a similar vein, Cambrea et al. (2023) find that a critical mass of at least three female directors is associated with a higher ESG performance in a sample of Italian listed firms.

Based on these previous findings, we expect that the appointment on the board of a critical mass of female directors may positively affect the CSR performance of our sample firms. Thus, we state our first hypothesis as follows:

> *H1: A critical mass of female directors is positively associated with CSR performance*.

While the above arguments may explain why a women critical mass can positively influence the CSR performance, it is important to shed light on how this positive association might differ according to the firm's ownership structure, which is considered as a possible driving factor of the appointment of female directors (Saeed et al., 2016; Ben-Amar et al., 2013).

In particular, as regards the family ownership structure, literature suggests that the appointment of female directors is often instrumental for family owners to improve firm success, avoid conflict and favour family harmony, thus improving both family and business image (Samara et al., 2019). Research suggests that board gender diversity may differently affect CSR performance according to the family firm status, although without providing conclusive results. For instance, Gavana et al. (2023) report in a panel of companies listed in five European countries that the presence of women on the board increases family firms' social commitment. Likewise, Beji et al. (2021), analysing a sample of French listed firms, document that board gender diversity is positively related with CSR performance especially in family firms. Similar results are reported by Cordeiro et al. (2020), who find in a sample of US companies that the effect of board gender diversity on environmental performance is higher in family firms. However, Cruz et al. (2019), on a sample of publicly held US family firms, show that the increase of CSR performance associated with the presence of women directors occurs only when the latter are family insiders. By contrast, Veltri et al. (2021), covering Italian listed firms, find that female directors have a negative and not significant effect on the CSR performance of family firms.

Furthermore, it is still unclear whether family firms are more likely than non-family firms to implement CSR practices and different theoretical frameworks provide alternative predictions. Some studies suggest that, due to the second type agency problem, family firms are more prone to achieve and satisfying family owners interests, while devoting less attention to other stakeholders needs, thus reducing investments in CSR activities (Veltri et al., 2021). According to this view, the 'amoral familism' would lead family firms to behave in a self-serving way, reducing their commitment towards the improvement of the long-term well-being of external stakeholders, and therefore limiting their CSR efforts (Gavana et al., 2023; Morck and Yeung, 2004). In contrast, studies based on the Socio Emotional Wealth (SEW) approach suggest that family firms pay more attention to the interests of external stakeholders as they perceive them not as a threat but as an opportunity to protect and increase family reputation (Labelle et al., 2018; Cennamo et al., 2012). Thus, from this alternative perspective, family firms are more likely to adopt CSR practices because this might improve their SEW (Gomez-Mejía et al., 2011; Berrone et al., 2012).

In light of these competing arguments, we state the following non-directional hypothesis:

H2: The family firm status influences the firm's CSR performance.

As regards the role of female directors in family firms, we find again competing arguments in the literature, that reflect the alternative views referred to above. From the SEW perspective, scholars suggest that family owners are likely to appoint women directors to support and advance their CSR agenda (Cordeiro et al., 2020). Thus, when a critical mass of women on board is appointed, they will likely support the commitment of family owners towards CSR, using their influence on the board to place CSR issues at the centre of the board debate and decision-making (Li et al., 2017; Lu and Herremans, 2019; Post et al., 2011; Walls et al., 2012). This may be especially true if we consider that women directors are often appointed as 'family delegates' to support the preferences of family owners through their influence on strategic corporate decisions, including those relating to CSR (Abdullah, 2013; Rodríguez-Ariza et al., 2017). Cordeiro et al. (2020) provide evidence for this claim, showing that family ownership interacts with board gender diversity to positively influence CSR performance.

Conversely, other scholars argue that the positive association between board gender diversity is less pronounced, if not absent, in family firms (Veltri et al., 2021), which may appoint family-affiliated women directors for other reasons

such as nepotism, dynastic management (Gonzales et al., 2020) or for mere 'tokenism' to comply with quota regulations. In the absence of unique personal assets to justify their appointment on the board, female directors who are affiliated with family owners might be deemed token.

Still others argue that both family and nonfamily female directors might hold a preference for CSR activities, even though not all female directors possess the same power and legitimacy to push a CSR agenda that fits their preferences (Cruz et al. 2019). Again, given the competing perspectives on the issue, we state the following non-directional hypothesis:

> *H3: The family firm status moderates the impact of a critical mass of female directors on CSR performance.*

3 Research methodology

3.1 Sample

Our initial sample comprised all firms listed in the Italian stock exchange in the year 2019. Data were collected from multiple sources. The corporate social responsibility (CSR) scores were collected from the Refinitiv Eikon database. Financial and accounting data were sourced by AIDA. Corporate governance data such as the number of female directors, independent directors and CEO duality were hand-collected from the corporate governance reports. To test our contingency hypothesis (H3), we differentiate the sample firms between family and nonfamily firms using a dummy variable. Following prior family business research, we classify as family firms those where 1) a dominant family owns, either directly or through holdings, the 30% or more of company shares (Anderson and Reeb, 2004; Miller et al., 2014); and 2) one or more family members are involved in the Board of Directors (Culasso et al., 2015). The 30% threshold is considered a suitable proxy for family control in prior studies on listed firms and even more so for the Italian stock exchange given its features both in terms of average size and average stock ownership (Minichilli et al., 2016). In order to detect the family identity of board members, we relied primarily on surname commonality with the owning-family as indicated in corporate governance reports, but also on publicly available information from company websites, directors' profiles on their web pages and professional social networks and specialized press articles. Thus, the Family Firm dummy is coded 1 if both conditions 1) and 2) are met, and 0

otherwise. Defining family firm status with a dummy is consistent with the argument that the influence of family owners may not be uniquely a function of their ownership stake but is also contingent on their internal and external power, prestige and visibility as major owners (Dow and McGuire, 2016).

After removing firms with missing data, we were left with a final sample of 76 firms. This is mainly due to the limited number of ESG scores available on Refinitiv Eikon for Italian listed firms.

3.2 Variable measurement

Our dependent variable, the corporate social responsibility (CSR) performance, is measured using the aggregate environmental, social and governance (ESG) score provided from the Refinitiv Eikon database. The Refinitiv ESG score measures the firm's ESG performance based on publicly reported information. It captures and calculates over 630 firm-level ESG measures, of which a subset of 186 of the most comparable and material per industry inform the overall scoring process. The underlying measures are based on considerations around comparability, impact, data availability and industry relevance that varies across each industry group.

The ESG score embraces ten categories (resource use, emissions, innovation, management, shareholders, CSR strategy, workforce, human rights, community, and product responsibility) weighted proportionately and rolled up into three pillar scores, i.e., the environmental, social and corporate governance scores. The ESG score ranges from 0 to 100, based on the data points that Refinitiv Eikon assigns to the above ten categories.

The independent variables of interest are two. The first one is the presence of a critical mass of female directors, which we capture using a dummy variable coded 1 if there are at least three female directors on the board, and 0 otherwise. The second one is the family firm status as described above.

Following prior research (Beji et al., 2020; Cordeiro et al., 2020; Veltri et al., 2021), we control for other corporate governance variables that may affect the CSR performance such as board size, CEO duality and the percentage of independent directors on the board.

We control for the impact of board size because, according to neo-institutional and stakeholder theories, large boards may balance the interests of diverse stakeholders and, therefore, they may increase the firm's involvement in CSR

activities. Previous studies such Beji et al. (2020) and Veltri et al. (2021) find a positive association between board size and CSR performance. As for the effect of independent directors, scholars argue that boards with more independent directors have more information and knowledge for monitoring the firm's CSR performance (de Villiers et al., 2011). Studies such as Shaukat et al. (2016) and Harjoto et al. (2015) provide evidence that independent directors have a positive impact on CSR.

Finally, based on prior studies, CEO duality is expected to reduce the firm's commitment to CSR activities. The rationale is that entrenched CEOs, under shareholders' pressure, could prioritize short-term financial performance to the detriment of long-term strategic investments such as CSR ones. Beji et al. (2021) and Gong et al. (2021) find evidence of this negative effect of CEO duality.

As additional control variables at firm level, we include firm size, the debt-to-equity ratio and the return-on-assets (ROA) ratio. The control for firm size is particularly important, because ESG scores can be subject to firm size bias (Drempetic et al., 2020) as bigger firms may use economies of scale to enhance ESG performance. We use the natural logarithm of total assets as a proxy for firm size. The debt-to-equity ratio is used as a proxy for firm leverage to control for the impact of financial risk on firm ESG performance (Simnett et al., 2009). As more profitable firms are more likely to have better ESG performance, we also control for firm profitability using the ROA ratio (Liang and Renneboog, 2017). Industry effects are also accounted for.

Table 1 summarizes the definition and measurement of all the variables used in the econometric analysis.

Table 1. Variables definition and measurement

Variable	Description	Source
ESG	Environmental, social and governance scores	Refinitiv Eikon
Family firm	It equals 1 if the company is a family firm; equals 0 otherwise	Corporate Governance Report
Critical mass	It equals 1 if there are 3 or more than 3 female directors on the board; it equals 0 otherwise	Corporate Governance Report
Independent	The percentage of outside directors on the board	Corporate Governance Report
CEO duality	It equals 1 if the CEO and chairperson are the same person; it equals 0 otherwise	Corporate Governance Report
Board size	Log-transformed of number of members on the board	Corporate Governance Report
Firm size	Log-transformed of total assets	AIDA Database
ROA	The percentage of return on assets	AIDA Database
Leverage	Total debt/total assets	AIDA Database

4 Results

In order to test our hypotheses, we estimate the following model by using an ordinary least squares (OLS) regression, where the critical mass of women on the board (Critical mass), the family firm status (Family firm) and the interaction term between the Critical mass variable and the family dummy (Critical mass*Family firm) are the main variables of interest:

CSR Performance (ESG) = b_0 + b_1 Family firm + b_2 Critical mass + b_3 Family firm* Critical mass + b_4 Independent+ b_5 CEO duality + b_6 Board size + b_7 Firm size + b_8 ROA + b_9 Leverage + Industry + ε

Table 2 presents the descriptives statistics and pairwise correlations between the variables. The average value of the CSR performance, as measured by Refinitiv ESG scores, is 64.74 with a standard deviation of 16.20 which indicates a large variation in this performance measure. Family firms account for more than 40 percent of the sample. More than three-quarters of firms (77%) have at least three female directors on the board. The board size is 11 members, which is in line with recent research covering Italian listed firms (Veltri et al., 2021; Cambrea, 2023).

The results of the correlation analysis show that the 'Critical mass' variable has a positive and significant association with the ESG variable, providing some initial support to our first research hypothesis. The 'Family firm' variable is negatively correlated to ESG, which would suggest that family firms are less engaged in CSR than nonfamily firms, even though the correlation is not statistically significant. Regarding the other firm-level controls, only firm size has a positive and significant correlation with ESG, which is consistent with the argument that there may be economies of scale in CSR activities.

The correlations between the explanatory variables are generally low. The highest correlations are 0.66 between the Critical mass and Board size variables, and -0.31 between CEO duality and Firm size, which are still below the commonly accepted cut-off of 0.70 to detect multicollinearity. Furthermore, as the VIF values are well below the warning value of 10 (Myers, 1990), we can conclude there are no significant multicollinearity issues in our regression.

Table 2. Means, standard deviations, VIF, and pairwise correlations

	Mean	SD	VIF	1	2	3	4	5	6	7	8	9
1. ESG	64.74	16.2		1.00								
2. Family firm	0.42	0.50	1.88	-0.08	1.00							
3. Critical mass	0.77	0.42	2.87	0.08*	-0.05	1.00						
4. Independent	0.67	0.19	1.40	0.03	-0.14	0.096	1.00					
5. CEO duality	0.16	0.37	1.52	-0.03	0.07	-0.11	-0.14	1.00				
6. Board size	11.18	4.76	2.24	0.12	0.11	0.66*	-0.07	-0.08	1.00			
7. Firm size	14.01	1.72	2.05	0.59*	-0.22	0.02	0.20	-0.31*	-0.04	1.00		
8. ROA	2.98	6.14	1.64	0.07	-0.01	-0.11	-0.15	0.10	0.07	-016	1.00	
9. Leverage	0.67	1.29	1.47	0.02	-0.01	0.00	0.13	-0.08	-0.05	0.23*	-0.07	1.00

***, **, * indicate significance at 0.1% and 1% and 5%, respectively. In parentheses are t statistics.

Table 3 presents the estimation results of our econometric model with and without the interaction effect of the family firm status. Our first hypothesis (H1) predicts that having a critical mass of at least three female directors leads to improving CSR performance. As Model 1 shows, the regression coefficient on the 'Critical mass' variable is positive and significant ($\beta = 5.71$, $p < 0.001$). This would mean that, compared to firms with less than three women on their boards, firms with a critical mass of female directors have a better CSR performance. Hypothesis 1 is thus supported. This result is consistent with previous research (e.g., Kassinis et al., 2016; Gong et al., 2021; Cambrea et al., 2023), that also finds a positive association between a critical mass of at least three female directors and CSR performance.

Table 3. Multiple regression analysis with main and interaction effect

	ESG performance	
	Model 1	**Model 2**
Family firm	-11.31***	-12.11***
	(-4.38)	(-12.35)
Critical mass	5.71***	3.45***
	(7.19)	(4.52)
Critical Mass*Family firm		14.33***
		(13.51)
Independent	6.46***	2.15**
	(5.44)	(2.05)
CEO duality	-0.82	-2.88***
	(1.21)	(4.77)
Board size	3.90***	2.80***
	(6.66)	(5.44)
Firm size	9.13***	5.95***
	(55.65)	(41.40)

ROA	0.47***	0.28***
	(12.02)	(7.91)
Leverage	-1.76***	-2.42***
	(-10.06)	(-15.81)
Industry	Yes	Yes
Constant	-77.37***	-17.54***
	(-27.69)	(-7.16)
N	76	76
R^2	0.54	0.58

***, **, * indicate significance at 0.1% and 1% and 5%. In parentheses are t statistics.

Turning to our second hypothesis (H2), results show that the coefficient on the 'Family firm' dummy is negative (β = -11.31, p < 0.001) indicating that family firms present a lower level of CSR performance compared to their nonfamily peers. This is consistent with the findings of Veltri et al. (2021), who also cover the Italian listed firms distinguishing between family and nonfamily firms.

Our third hypothesis (H3) predicts that the family firm status positively moderates the association between a critical mass of women on the board and CSR performance. The positive coefficient on the interaction term 'Critical mass*Family firm' in Model 2 (β = 14.33, p < 0.001) lends support to this hypothesis as well. We interpret this result as being consistent with the argument that family owners who are more prone to engage in CSR activities will appoint a critical mass of female directors to advance their CSR agenda (Cruz et al., 2019; Cordeiro et al., 2020).

As regards the control variables at board level, we find that board size has a positive association with ESG, which supports the argument that large boards may boost the firm's CSR performance because they are more effective in balancing the interests of diverse stakeholder groups. The coefficient estimates on CEO duality and independent directors also have the expected sign.

As for the firm-level control variables, we find that firm size is positively related to CSR performance, suggesting that the larger the firm size, the more likely the firm is to engage in CSR activities. The coefficient estimates on ROA and leverage are respectively positive and negative, consistently with some previous findings (e.g., Bruna et al., 2021).

5 Conclusions

Our study aims to examine the impact of the critical mass of female directors on CSR performance and whether the family firm status has a moderating role on

this relationship. Based on a sample of 76 Italian publicly listed firms for the year 2019, the empirical analysis provides evidence that having a critical mass of female directors increases the CSR performance as measured by ESG rating. This supports the conclusions of prior studies suggesting it is not so much the appointment of female directors (Birindelli et al., 2019; Samara et al., 2019; Loukil and Yousfi, 2016), but rather the presence of a critical mass of women that has implications for CSR (Fernandez-Feijoo et al., 2014; Cabeza-García et al., 2018). Specifically, this finding corroborates prior evidence highlighting that having boards with a critical mass of at least three female directors improves CSR also in terms of outcomes (Post et al., 2011; Bear et al., 2010; Kassinis et al., 2016; Cambrea et al., 2023). In addition, the empirical analysis shows that the family firm status has a negative direct effect on CSR performance, but has a positive interaction effect with a female critical mass. Overall, these findings support the conclusion that the effect of female directors on CSR performance is influenced by the family ownership structure (Gavana et al. 2023; Beji et al., 2021; Cruz et al., 2019; Veltri et al., 2021; Cordeiro et al, 2020). Specifically, on the one side, results suggest that family firms are overall more likely to behave in a self-serving way, reducing their CSR efforts (Morck and Yeung, 2004). On the other side, results suggest that, when a critical mass of women is appointed on the board, the commitment of family firms with CSR improves, because a female critical mass fosters the probability that CSR issues are placed at the centre of the board's debate and decision-making (Li et al., 2017; Cordeiro et al., 2020) with positive consequences for CSR performance.

Our paper makes several contributions to the literature on gender diversity and family business and provides implications for practitioners as well. First, by focusing on the role of the critical mass of female directors, it integrates the research on the implications of women on board for company performance by providing empirical evidence on its effect on CSR performance. Second, it advances the scholarly debate on the determinants of ESG rating as proxy for CSR outcomes. Third, by exploring the moderating role of family ownership for the relationship between the critical mass of female directors and CSR performance, our article sheds light on how this governance mechanism is able to affect firm outcomes in terms of CSR. Finally, from a practical standpoint, by highlighting the importance of women directors, our study advises the board nomination committees on the importance of appointing a critical mass of female members to improve CSR outcomes.

In spite of its potential contributions, this paper presents some limitations that provide opportunities for further research. A first limitation is related to the employed sample, which only includes Italian listed firms. Future studies might investigate alternative settings, e.g., enlarging the analysis to other European countries characterized by different gender quota rules, so as to assess whether the effect of the critical mass on CSR performance differs according to the institutional setting. A second limitation relates to our measure to capture the family business status (i.e., dummy variable). In this regard, future research might better disentangle family firms' heterogeneity by analysing, for instance, the share owned by the family, the generational stage or the composition of the family group on the board. Finally, while we use the critical mass as a key independent variable to assess the impact of board gender diversity, future research ought to focus on the roles covered by female directors (e.g., independent, CEO, CFO, chairman) and on the specific human and social capital they bring to the boardroom (Hillman and Dalziel, 2003), so as to investigate whether and how their roles and intellectual capital shape the reported relationship between the female critical mass and CSR performance.

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Our Business is Different: How are Inclusive and Sustainable Business Models Tackling Hybridity towards Sustainability?

Federico Ceschel

Roma Tre University
Via Silvio D'Amico, 77

Plinio Limata*

Roma Tre University
Via Silvio D'Amico, 77

Lucia Marchegiani

Roma Tre University
Via Silvio D'Amico, 77

** Corresponding author*

Abstract

The United Nations and the Agenda 2030 have clearly recognized the role of for-profit organizations in boosting sustainable development and reducing inequalities. This process has led to a profound change in International Development Cooperation (IDC), where private enterprises are called to develop Inclusive Businesses (IB) aligning business values with social impact, following responsible environmental, social, and governance standards. This result is often reached through the creation of *Hybrids*, combining different organizational logics (e.g., social and commercial). In this research, we will focus on this last aspect (sustainability). Using interviews and focus groups, we aim at highlights those elements of tensions that derive from hybrids and sustainability goals. Hybridization involves a mix of different organizational logic (e.g., commercial vs. social) that may have different outcomes (e.g., innovative patterns or challenges and disagreement); therefore, we aim to understand how hybridization has been reflected in Knowledge Management practices between local and international dimensions. Moreover, as businesses are asked to submit a project proposal to get access to funds by AICS (in line with Lundin et al., 2015), we aim to explore how organizational logic is affected by the institutional framework and social goals (Sabini and Alderman, 2021) provided by IDC (e.g., what elements differ from a traditional pattern of internationalization), and whether such

tensions due to hybridity can be reconciled through sound knowledge management practices.
While during the years, the former (inclusive and sustainable models) has experienced a growth in numbers and quality of the proposal, the latter (HR Management) seems confined to traditional practices that do not take into consideration the peculiarities of the local dimension, showing an increasing tension between business and social (and sustainable) goals.

Keywords – Sustainability, Development cooperation, Hybrid Organization, Institutional logic, Knowledge management.

Paper type – Academic Research Paper

1 Introduction

A growing awareness of corporations' impact on the global value chain and globalization has been paired with wider attention towards sustainability and sustainable development. This has contributed to envisioning new ways of business-making, especially for marginalized areas of the globe. International Development Cooperation (IDC), which was once conceived as the trigger in the hands of developed northern countries to accelerate the development of poorer world countries, has undergone a profound change, and the role of for-profit organizations has been boosted. This process is meant to stimulate positive social change – PSC (Stephan et al., 2016), in light of a coopetitive advantage (Morioka et al., 2017). Business, society, and the environment are interdependent (Porter and Kramer, 2006; 2011), and the Creation of Shared Value (CSV) is possible and needed in developing countries (Reinecke and Donaghey, 2020; Jamali and Karam, 2016; Cafferata, 2009). This process produced several concepts and approaches (Corporate Social Responsibility, Triple Bottom Line, Corporate Social Entrepreneurship, Shared Value Creation, Global Corporate Citizenship) that highlight the opportunities that emerge from the engagement of the private for-profit sector in IDC. An increasing global understanding envisions the private sector as part of the global IDC system in reducing inequalities (Deloitte, 2018) and alleviating social and environmental issues (Santos et al., 2015, Haigh et al., 2015). Corporations may pursue inclusive growth, diminishing trade-offs between growth and inequality (George et al., 2012). The market is shifting to the periphery by means of ''sustainability-driven'' commercial initiatives (Haigh and Hoofman, 2012), stressing the importance of corporate citizenship (Deloitte,

2018). In 2015, the UN 2030 Agenda for Sustainable Development recognized this role explicitly (i.e., Paragraph 67 of the Declaration of Resolution A/RES/70/1). Since then, many donor agencies have embraced the concept of "Profit for Development", igniting and promoting inclusive and sustainable business models (UNDP, 2008).

2 Aim of the research

Recent research has highlighted the positive nexus between Social Entrepreneurship, Inclusive Business, and SDGs (e.g., Wang et al., 2020; Günzel-Jensen et al., 2020; Eichler and Schwarz, 2019; Littlewood and Holt, 2018; Quiroz-Nino and Murga-Menoyo, 2017; Doherty, 2018). There is also evidence that Hybrid Organizations play a relevant role in achieving the SDGs in domestic (Horne et al., 2020) and foreign issues (Conway et al., 2019). However, SDG applicability is still challenging for enterprises since it depends on quantifiable outcomes that reach SDGs targets and indicators. Not all firms can measure the plethora of benefits they bring to society (Tabares, 2021). Moreover, hybrids are subject to many counter-effects, such as mission drifts, when the organizational mission is insufficiently institutionalized, and the organizational mandate is not fully reflected in the business model (Ramus and Vaccaro, 2017). Thus, it is still unclear whether a new pattern of private engagement in IDC could effectively substitute the non-sustainable patterns of internationalization or whether the drifts and hybridity threats could challenge the outcome of inclusivity and sustainability.

In this research, with the use of interviews and focus groups, we aim at highlights those elements of tensions that derive from hybrids and sustainability goals. Hybridization involves a mix of different organizational logic (e.g., commercial vs. social) that may have different outcomes (e.g., innovative patterns or challenges and disagreement); therefore, we aim to understand how hybridization has been reflected in Knowledge Management practices between local and international dimensions. Moreover, as businesses are asked to submit a project proposal to get access to funds by AICS (in line with Lundin et al., 2015), we aim to explore how organizational logics are affected by the institutional framework and social goals (Sabini and Alderman, 2021) provided by IDC (e.g., what elements differ from a traditional pattern of internationalization), and

whether such tensions due to hybridity can be reconciled through sound knowledge management practices.

3 Inclusive Business and HRM

Diversity and an inclusive workforce are crucial drivers of innovation and critical components of global success. Enterprises have to be culturally sensitive (Forbes, 2011) since there are many specific human resource system development characteristics in various countries and under different conditions (Chlivickas, 2014). Human capital development policies require culturally sensitive and creative solutions designed for specific contexts, being respectful of exogenous factors such as laws and regulations, language, and cultural barriers that vary from region to region (Forbes, 2011). Therefore, companies may face strategies and methodologies of doing business very different from those they are accustomed to. Therefore, an effective combination of local and global knowledge is needed (George et al., 2012). This is especially true in the case of Inclusive Business (IB): embracing shared value creation and diminishing trade-offs between growth and inequality (George et al., 2012; UNDP, 2010). An Inclusive and Sustainable Business (ISB) embraces shared value principles by aligning business values with social impact, following responsible environmental, social, and governance standards. Nevertheless, only if businesses put a transformative power and genuinely embrace sustainable development agendas, the threats of avoiding further entrenching the neoliberal mechanisms that have contributed to societal inequalities (Scheyvens et al., 2016). A vast literature has referred to these businesses as hybrids (e.g., Holt and Littlewood, 2015; Schoneveld, 2020). These are organizations combining different organizational logics (Alexius and Furusten, 2019), where "the distinction between social and commercial entrepreneurship is not dichotomous but rather […] a continuum ranging from purely social to purely economic. Even at the extremes, there are still elements of both" (Austin et al., 2006, p. 372). In IDC, a dual process of hybridization has taken place: Efficiency for NGOs, and "Humanization" for Private for-profit Enterprises.

Among the policies that people management entails, recruitment is surely one of the most impacting the execution on any business model, and especially a business model that aims at inclusivity, sustainability and innovation. In fact, selecting the right persons that share values and attitudes with the organization is

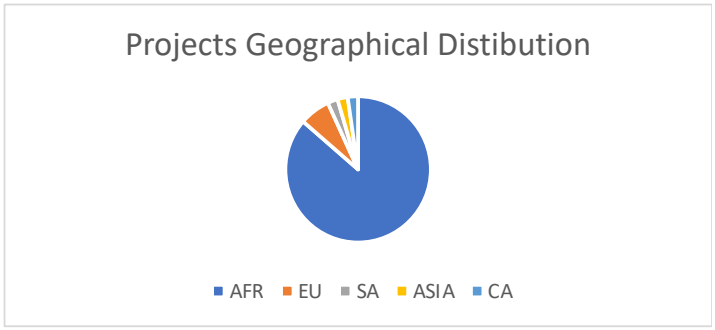
mandatory to set up a good work environment where the objectives of inclusive business can be pursued. Although also in traditional business the criteria for selecting workers are satisfied by objective data (curricula vitae; letters of presentation; previous experience; technical skills acquired, etc.), as well as psychological profile, this is particularly crucial in the inclusive business. In these cases the candidate's technical-productive skills might also be less important than her values and psychological profile, and how congruent this is with the needs of the company and its culture. Therefore, the objective methods based on curricula screening (which assesses the suitability of candidates in accordance with objective requirements such as the languages known or the level of education), must be integrated with other assessment methods. The internal organization of companies that undertake an inclusive business project should not be centred only on factors of technical and economic rationality (as in the for-profit company) or "formal" rationality (as in public administrations) but on the exaltation of role and subjectivity of people who use technical, economic and formal rationality, but are not subordinate to it.

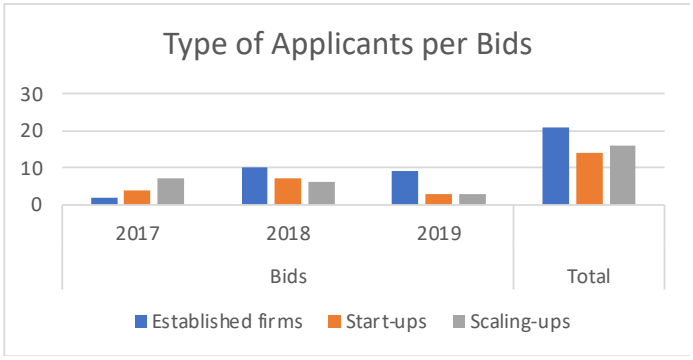
3.1 Italian Development Cooperation Bids

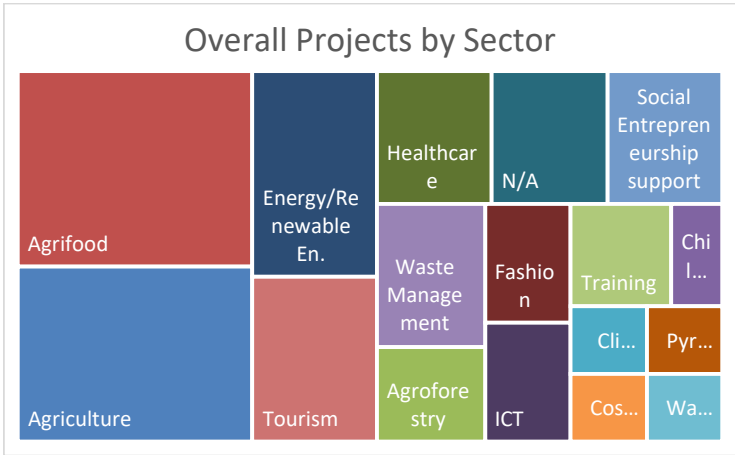
3.1.1 IDC, Hybridity and HRM

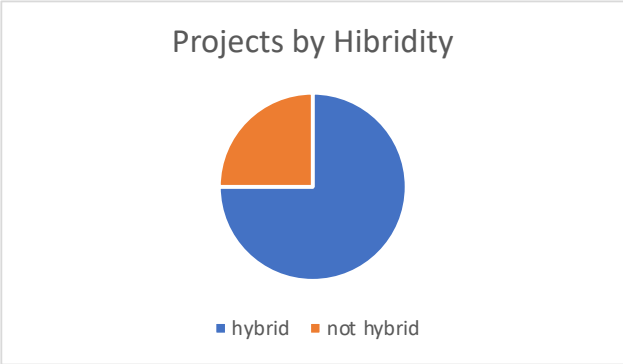
Our empirical setting focuses on Italy. As a precursor in the international setting, the Italian reform of Development Cooperation in 2014 (law 125) anticipated the objectives and principles of the 2030 Agenda, especially as regards the role of the private profit sector, recognizing its role as a development actor (art. 27). The reform has also allowed the establishment of the Italian Agency for Development Cooperation (AICS), which has to date published 3 calls for cooperation for private companies. Being engaged in action research with AICS since 2017, the research team has already been analysing the hybridity of the projects based on inclusive and sustainable business models that have been funded over the years by AICS, with a focus on the Human resource management practices that have been entailed within the projects.

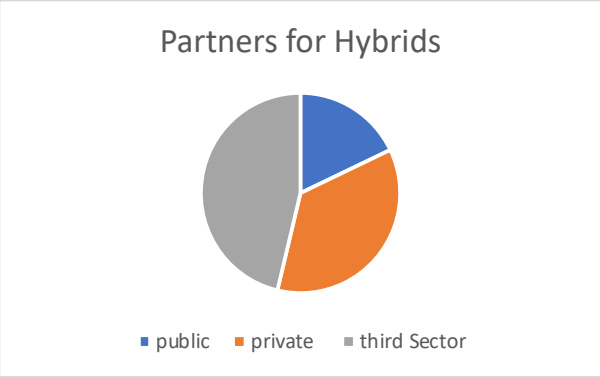
The following graphs show the picture offered by the projects' applications analysed.


Projects Geographical Distibution
AFR
EU
SA
ASIA
CA


Type of Applicants per Bids
30
20
10
0
2017
2018
2019
Total
Bids
Established firms
Start-ups
Scaling-ups


Overall Projects by Sector
Agrifood
Agriculture
Energy/Renewable En.
Tourism
Healthcare
N/A
Social Entrepreneurship support
Waste Management
Agroforestry
Fashion
ICT
Training
Chi l...
Cli...
Pyr...
Cos...
Wa...





As the graphs show, sectors of applications are quite different, and identifying a single model of Inclusive Business is out of the scope of this paper. However, we focus on two dimensions that emerged as common to all: 1)Human Resource Management (HRM), in particular, recruiting; 2) the elements of tensions between the requests of the bids and entrepreneurs' attitude towards the challenges and rewards offered by the implementation of an Inclusive Business (IB).

1. With regard to the HRM, the local workforce was involved just in physical production, while the rest of the operations were performed by local offices managed by an Italian staff or project managers that were trained in Italy. Recruitment was generally assigned to local staff intermediation services using traditional business tools. The training and re-training was a process directly managed by the company as well, since in most cases workers' skills were not in line with needs because of a lack of methodological knowledge or knowledge of using, for example, the appropriate machinery. In general, the level of specialization has rarely been rated satisfactory by companies. As in

the case of recruitment, the practices and tools of training activities did not differ much from the usual ones of domestic businesses, if not in the very difference in the specialization of workers and farmers, in the different work culture, and conceiving an economic activity.

2. With respect to the elements of tensions between the requests of the bids and entrepreneurs' proposals, here are the followings:
    - The concept of development cooperation presents elements of confusion with internationalization, which emerges as the second main reason to be engaged in the bids.
    - Criticality in adapting the traditional scheme of the business plan to the innovative and sustainable business model required by the AICS, in particular considering the uncertainties of the local contexts;
    - The vast majority of applicants believe their enterprise is prepared to deal with the request and criteria of the bid;
    - Need of networking with realities in third countries.

4 Conclusions

While during the years, inclusive and sustainable models have experienced a growth in numbers and quality of the proposal, HR Management seems confined to traditional practices that do not take into consideration the peculiarities of the local dimension, showing an increasing tension between business and social (and sustainable) goals.

The entrepreneurial system seems not ready yet to address the organizational challenges implicit in the "Profit for Development" paradigm: the creation of inclusive businesses and/or hybrid organizations to create shared value. Many projects were in line with the principles of IDC, but in some cases, they were just projects of internationalization.

In some cases, the applicants were not familiar with hybrid models, and this poses a serious concern regarding a managerial gap to be solved for creating hybrid organisations and workforce management, which cannot be recruited and trained with traditional frameworks.

Through the analysis of the projects presented to the Italian Agency for Development Cooperation, we show that traditional enterprises still lack the mindset and required competencies to engage and manage hybrid partnerships

that put together for-profit and not-for-profit organizations at both national and international levels. This is testified by the conservative approach in human resources management (HRM) strategies and policies.

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The Role of Corporate Entrepreneurship in Society and Industry 5.0 Era

Ricky Celenta*

Department of Management & Innovation Systems
University of Salerno
Via Giovanni Paolo II, 132 - 84084 – Fisciano (SA) Italy

Massimiliano Vesci

Department of Management & Innovation Systems
University of Salerno
Via Giovanni Paolo II, 132 - 84084 – Fisciano (SA) Italy

Roberto Parente

Department of Management & Innovation Systems
University of Salerno
Via Giovanni Paolo II, 132 - 84084 – Fisciano (SA) Italy

Rosangela Feola

Department of Management & Innovation Systems
University of Salerno
Via Giovanni Paolo II, 132 - 84084 – Fisciano (SA) Italy

** Corresponding author*

Abstract

Society 5.0 and Industry 5.0 concepts are gaining more importance in the academic and political debate, going beyond the boundaries of the policy brief, and becoming growth models interesting for other countries (Fukuyama, 2018; Carayannis, 2021). These new paradigms start from different focuses, one on society and another on the industry, but there are many common elements.

Our interest in this paper is to highlight the common point of this element, with the intent to identify the "Context 5.0". This Context 5.0 involved many actors, including government, industry, and Civil Society. As Management and Entrepreneurship scholars, in studying this new context our focus is on the role of industries.

In this paper, we aim to understand how Corporate Entrepreneurship can support companies that want to do business in line with the imperative of Context 5.0 and finally

open a debate based on the possibility of integrating the theory of Humane Entrepreneurship with Corporate Entrepreneurship.

Keywords – Society 5.0, Industry 5.0, Corporate Entrepreneurship, Humane Entrepreneurship.

Paper type – Academic Research Paper

1 Introduction

We are not living in an epoch of change; we are living in an epochal change. Pandemics, wars, social inequalities, and environmental disasters are some of the dramatic events that have characterized the entire course of humanity. Today, however, we live in a globalized world, in which the challenges affect everyone in different ways, and are too great to face individually. The good news is that we have technologies and tools that are redefining the concept of space-time limits and boundaries, giving us unprecedented opportunities to face and overcome global challenges. In every country, in every sector, and in every market, innovation, not only technological, is generating new ways of creating value (Kuratko, 2009). However, individual technologies and strategies are not enough, we need to develop new strategies based on cooperation between government, industry, and civil society, aiming at sustainable growth models (Carayannis et al., 2012; 2021; 2022).

Society 5.0 and Industry 5.0 are just that: strategies for sustainable development. Developed by the Japanese government and the European Commission respectively, these are aimed at solving the challenges of our time through a systemic approach, and the development of human-centered and innovative solutions. As highlighted by many scholars (Eisenhardt, Brown, and Neck 2000; Covin, Slevin, & Heeley, 2000; Kuratko, 2009), Entrepreneurship and Innovation are the approaches to sustain the process of creating value and obtaining competitive advantage and success in organizations of all types. In this context, as Management and Entrepreneurship scholars, in studying these "5.0 strategies of sustainable growth", our focus is on the role of industries. Our interest lies in understanding how business needs and dynamics may well coincide with the imperatives imposed by societal development models. Literature on business and organization highlighted that there are several reasons why companies should decide to pursue social and environmental objectives

through their business. As shown by Orlitzky et al. (2003), there is a positive relationship between the pursuit of social and environmental responsibility results and financial performance, especially when considering long-term financial results (Chatterji and Toffel, 2010). In addition to the impact on financial performance, Sharma and Vredenburg (1998) demonstrated how companies that adopt proactive environmental strategies can develop organizational capabilities that create competitive advantages, including improved stakeholder relations, enhanced technological capabilities, and increased innovation. Other scholars (Rupp et al., 2006; Turker, 2009), on the other hand, have shown that companies that engage in socially responsible initiatives are more motivating for employees, who tend to be more committed, more loyal and find greater satisfaction from their work, especially when the company's values are in line with their values.

Many scholars are pointed out how corporate entrepreneurship can be a method to achieve high levels of organizational performance in this global and challenging world (Kuratko 2009; Morris et al. 2011; Kuratko, Hornsby, and Hayton, 2015; Audretsch et al., 2015). However, to our knowledge, there are no studies that highlighted the role that CE can assume in the context of Industry and Society 5.0. In this paper, we aim to understand how Corporate Entrepreneurship can support companies that want to do business in line with the imperative of "Context 5.0". Especially we want to answer this research question:

RQ1: How can Corporate Entrepreneurship support the development of Industry 5.0 and Society 5.0?

RQ2: What contribution can Humane Entrepreneurship make to Corporate Entrepreneurship?

The novelty of the phenomena under observation requires us to take a methodological approach based essentially on the study of policy briefs and the little literature currently available on Industry 5.0 and Society 5.0, an analysis of the recent developments in the literature on Corporate Entrepreneurship, and finally the opening of a debate based on the possibility of integrating the theory of Humane Entrepreneurship with Corporate Entrepreneurship.

Remarkably, the article is structured as the following. The first section discusses the topic's relevance and highlighted the intersection and common elements between the concept of Society 5.0 and Industry 5.0, to identify the elements of Context 5.0. The second section reviews the development of Corporate Entrepreneurship literature, to understand how CE contributed to the company dynamics and the third session analyzes which role the CE can be in Context 5.0.

In the fourth section based on the Humane Entrepreneurship model, we debate how the development of a Humane Corporate Entrepreneurship approach can support the transition of the company in Context 5.0. Our framework adds value to the ongoing scientific debate about I5.0 and S5.0, proposing a broad conceptual model to design the future role of companies in Context 5.0, especially to refer to the role of Corporate Entrepreneurship. Finally, implications, limitations, and future research directions are presented.

2 Literature review

2.1From analysis of Industry and Society 5.0 to the definition of Context 5.0

The concept of Society 5.0 is gaining more importance in the academic and political debate, going beyond the boundaries of the Japanese government's strategic plan "The Investment for the Future Strategy 2017: Reform for Achieving Society 5.0 (Cabinet Office, 2016) and becoming a growth model interesting for other countries (Fukuyama, 2018; Carayannis, 2021). Society 5.0 describes the next level of Society that follows the current 'Information Society' (Harayama, 2017). In this concept, digital technologies are used systemically, and cyber and physical space is merging to face and solve the profound sustainability challenges in a broad sense (Keidanren, 2017; Deguchi & Karasawa, 2020). Unlike other models (e.g., "Industry 4.0" or "Made in China 2025") in which digital technologies mainly support industrial activities, in Society 5.0 they are used to address the environmental and social challenges to build a human-centered society (Fukuyama, 2018; Holroyd, 2020; Carayannis, 2022). To implement the concept of Society 5.0 it is necessary for industry, politics, and civil society to work in synergy (Deguchi and Karasawa, 2020) and is necessary to integrate several dimensions, among them the entrepreneurial spirit and the entrepreneurial skills (Carayannis, 2021 about Yousefikhah, 2017). The willingness to integrate Industry 4.0 technologies, for the development of solutions capable of generating a positive impact on society, is also the concept behind the new industrial paradigm called 'Industry 5.0' (Carayannis, Canestrino, Magliocca, 2023). Industry 5.0 is the strategic plan developed by the EU following the Covid-19 shock. The effects on the economy and society were such that the EU had to rethink its industrial model and develop a plan to repair, protect and transform European society and economy (Renda et al., 2022). As stated in the Policy brief, the goal is to build on

the lessons learned and develop a new model of economy and Society that is people- and planet-centered, resilient, digital, and sustainability-oriented.

Both these paradigms, start from the assumption that the industry 4.0 model is a techno-centric model, which therefore does not consider humans and the environment as central (Longo et al., 2020; Müller et al., 2018). As highlighted by Carayannis (2023) Industry 4.0 is not a human-centric initiative "It lacks the necessary dimensions to enable systemic transformation and to guarantee the necessary decoupling of resources and their employment from negative environmental, climate, and societal impacts". The two paradigms are based on using the same technologies as Industry 4.0; however, they consider them as tools to realize economic, social, and environmental goals, in line with other strategies above all the Sustainable development goals.

A joint reading of the reference policy briefs ('The Investment for the Future Strategy 2017: Reform for Achieving Society 5.0' and 'Industry 5.0, a transformative vision for Europe: governing systemic transformations towards a sustainable industry') emerge as Society 5.0 and Industry 5.0 are both concepts that aim to integrate advanced technology with human society to create a more efficient, sustainable, and prosperous future. Here are four common elements between the two paradigms:

- Human-centric approach: Both paradigms focus on placing humans at the center of technological innovation. They prioritize the needs and well-being of people over purely economic or technological objectives.
- Integration of technologies: Both concepts rely on advanced technology to achieve their goals. Society 5.0 envisions a future where cutting-edge technologies such as AI, IoT, and robotics are seamlessly integrated into society to improve quality of life, while Industry 5.0 emphasizes the integration of new technologies such as AI, automation, and the Internet of Things (IoT) in industrial production processes, to the aim obtain a more sustainability and resilient production process.
- Sustainability: Both concepts emphasize the importance of sustainability in creating a better future. Society 5.0 aims to create a sustainable society where economic growth and environmental protection go hand in hand, while Industry 5.0 focuses on developing sustainable manufacturing processes that reduce waste and carbon emissions.

- Collaboration: Both concepts rely on collaboration and cooperation among different stakeholders, including government, businesses, civil society, and individuals. These paradigms aim to create a collaborative model of industry and society where various actors work together to achieve common goals. These paradigms consider not only the collaboration between different stakeholders but also highlighted the importance of collaboration between humans and machines. Both concepts aim to develop a new space for industry and society, without boundaries between cyber and physical space.

Overall, both Society 5.0 and Industry 5.0 seek to harness the power of technology to create a better future for humanity. They share a common goal of improving people's lives through innovation, while also addressing pressing social and environmental challenges. Through the analysis of policy briefs and the prevailing literature on the topics (Demir et al., 2019; Longo et al., 2020; Fukuda, 2020; Deguchi et al., 2020; Xu et al., 2021; Carayannis et al.; 2021; 2022; 2023), the main indications for companies emerge, regarding actions to be implemented and behaviours to be adopted to operate in line with the objectives of Context 5.0. To contribute to achieving the goals of Industry

5.0 and Society 5.0, companies are called upon to:

1. Rethink their business models, giving sustainability a central role in supporting growth strategies.
2. Developing human-centered and sustainable products and services using digital technologies.
3. Redesign process reshoring to reduce the overall environmental footprint.
4. Redesign value chains to embrace the new possibilities offered by technology and realize the economic and social well-being of the various stakeholders.
5. Adopt metrics and indicators to measure progress toward social impact and sustainability goals.
6. Develop a mindset at all company levels, putting the concepts of sustainable development and social challenges at the center of the value creation process.

As pointed out by Bansal and Roth (2000), companies engage in sustainability imperatives not only to comply with regulatory pressures but also to meet stakeholder demands and create a competitive advantage. The objective of

companies in Context 5.0 is to realize at the same time the business goals, and contribute to developing a more ethical society, which using Digital Transformation and Smart Technologies, can solve the complex environmental, economic, and social challenges, implementing a broad sustainability approach capable of offering all humans a happy life (Parente et al., 2021). This paper aims to highlight of Corporate Entrepreneurship can support the company's transition to Industry 5.0.

2.1 Corporate Entrepreneurship

CE is recognized as a strategic approach that supports corporate growth (Goodale et al. 2011), through the adoption of an ongoing process of entrepreneurial actions to achieve a competitive advantage (Kuratko and Morris, 2018). According to the study of Zhara et al. (1995; 1996, p.1715) here we define the CE as "the sum of a company's innovation, renewal, and venturing efforts". Innovation refers to the innovation of products, production processes, or organizational systems. Renewal refers to the process of revitalizing business operations, either through a change of activities, competitive approaches, or the acquisition and implementation of new capabilities. Venturing refers to the company's entry into new businesses. We decided to follow the Zahira approach and focus on the relationship between CE and innovation capability because as highlighted by Covin and Miles (1999) innovation is the central common theme underlying all forms of CE. Kuratko (2017) has brilliantly taken a picture of the development of CE literature over the last 50 years, pointing out that the three major domains are: corporate venturing, entrepreneurial orientation, and strategic entrepreneurship. According to Morris et al. (2011) the CE be manifested in companies either through two main categories of activities: corporate venturing and strategic entrepreneurship. Corporate Venturing regards the activities of innovation carried out through the creation of new businesses, internal or external to the company (we told of internal or external corporate ventures). Corporate venturing activities are pursued for at least three main reasons: 1) To improve and expand the competencies of the company to increase its innovative and entrepreneurial capabilities. 2) To expand the boundaries of the company's business in areas of possible strategic importance. 3) To generate financial returns (Tidd and Taurins, 1999; Miles and Covin 2002; Narayanan et al., 2009). Strategic entrepreneurship is a broader concept, in-fact it is possible to include in all

entrepreneurship initiatives, that the company decides to pursue to create wealth in a broad sense (Hitt et al., 2001), and not involve the creation of new business (Morris et al., 2011; Kuratko et al., 2015). These include innovation activities at different levels: product, process, business model, organization, competencies, and strategies (Ireland & Webb, 2007; Hitt et al., 2011; Kuratko and Audretsch, 2013).

As highlighted by Kuratko (2017) the theme of Entrepreneurship Orientation is central to the research on CE. This concept was coined by Covin and Slevin (1989) and Covin and Slevin (1991), who posited the existence of a continuum of a firm's strategic behavioral proclivities. A company is considered more entrepreneurial on the spectrum when evidenced by innovativeness (the introduction of new products, processes, and business models); proactiveness (actively entering new product/market spaces and seeking market leadership positions); and risk-taking (a willingness among strategic decision-makers to contribute resources to projects with uncertain outcomes).

Of course, scholars refer to the innovation activities driven by corporate entrepreneurship, when corporate venturing and strategic entrepreneurship activities don't are episodical events but are expressions of behavioral patterns that are recurring, and these are linked to the Entrepreneurial orientation domain of corporate entrepreneurship (Kuratko, 2017). In fact, according to Covin and Slevin (1991, p. 8), "Organizations with an entrepreneurial posture are those in which particular behavioral patterns are recurring." Companies judge the value of innovation to the extent that it becomes a corporate strategy to create a sustainable competitive advantage (Vanhaverbeke & Peeters, 2005). Companies that innovate by adopting a Corporate Entrepreneurship approach do so to pursue an entrepreneurial opportunity by taking the risk that innovation entails. In this sense, Ireland, Covin, and Kuratko (2009) define a corporate entrepreneurial strategy as "a vision-directed, organization-wide reliance on entrepreneurial behavior that purposefully and continuously rejuvenates the organization and shapes the scope of its operations through the recognition and exploitation of entrepreneurial opportunity'' (p. 21). In summary, we can say that companies have adopted CE as an approach to innovation to establish sustainable competitive advantages (Hornsby et al. 2009) sustain profitable growth (Kuratko et al. 2001) and so improve financial performance (Zahra,1991). However, the rules of Context 5.0, is that the logic of the competition is game-changing fast, and so companies are beginning to realize that sustainable

competitive advantage requires a new approach (Kuratko, 2009), and in this new context also evolving the role of Corporate Entrepreneurship (Kuratko et al., 2015).

3 The contribution of CE to support the business in Context 5.0

CE has been adopted by companies to restructure their activities at different levels to cope with Significant changes (Zahra, Kuratko, and Jennings, 1999). The innovation generated by an approach of CE can support the company in fundamental changes (Kuratko and Audretsch, 2013). Corporate venturing and strategic entrepreneurship involve both simultaneous opportunity-seeking and advantage-seeking behaviors (Ireland et al. 2003). As highlighted in the introduction, pursuing social and environmental impact through corporate business activities can generate better financial performance and improve employee engagement. Therefore, we believe that doing business following the logic of context 5.0 is consistent with both the pursuit of business opportunities and the pursuit of competitive advantage. In the second paragraph, we identified the six main challenges for companies that want to operate in the 5.0 environment. Now for each of the challenges, we will try to analyze how and whether CE can be a useful approach.

Rethink the Business Model: Business model innovations are one of the most significant elements in strategic entrepreneurship (Ireland et al.2003). In fact, through CE initiatives, companies design new business models or innovate previous ones to exploit specific market opportunities and build competitive advantage (Eckhardt 2013) and obtain a better performance (Cucculelli et al., 2013).

Developing human-centered and sustainable products and services: Kuratko (2009) highlighted how CE represents a guiding light approach to companies that want to innovate e develop new products that create real value for customers and obtain a sustainable competitive advantage. Product and service are one of the five areas of strategic entrepreneurship approaches (Morris et al., 2011), however, as highlighted by Zahra (1991), sometimes, through product innovation established firms create new businesses.

Redesign process: As observed by Zahra (1991) formal and informal activities that characterize the CE, can be aimed to realize the innovation of processes. According to Ireland & Webb (2007), process innovation is a sub-category of

internal organizational innovation, realized through strategic entrepreneurship initiatives.

Redesign value chains: According to Kuratko, Hornsby, and Hayton (2015), it is time for managers to focus on CE initiatives to innovate the value chain, following the approach of strategic thinkers (Govindarajan and Trimble, 2005). As shown by Kanbach and Stubner (2016), CE currently begins to support the emergence of new businesses and products that can have a positive impact on the company's value chain.

Adopt metrics to measure the impact: The development of impact measurement models and metrics is one of the fields of interest that has attracted the most interest from scholars in CE fields (Hornsby et al., 2002; Ireland et al. 2006; Morris et al., 2011; Covin and Wales, 2012). However, according to Kuratko (2017), corporate entrepreneurship as a strategy must be measured for its actual impact, and models and metrics have been a stronger theme to the challenge of CE in the 21st Century.

Develop a company mindset: As pointed out by Kuratako (2017), the entrepreneurial mindset is one key element in the implementation of EC initiatives, as it is strongly linked to the ability to identify entrepreneurial opportunities and risk-taking, elements that characterize all EC activities (Morris, Kuratko, & Covin, 2011). Zahra (2016) also highlighted a strong link between the achievement of the objectives of CE activities and the presence of a widespread entrepreneurial mindset among company managers.

Starting from the analysis of the challenges that industries face within the 5.0 context, we have highlighted here how Corporate Entrepreneurship initiatives could support companies that want to innovate and seize the opportunities offered by this paradigm shift. However, our reasoning lacks a fundamental element. For CE activities to concretely support the innovation processes of companies in the 5.0 context, the company must adopt an entrepreneurial posture consistent with the vision and values of the 5.0 context.

4 Towards a possible model of Corporate Humane Entrepreneurship

Already Burgelman (1984) pointed out that senior managers play a key role in the development and success of CE initiatives. Indeed, the role of top-level managers is central in defining the corporate strategy and thus the strategic and structural context within which entrepreneurial behaviour can take place (Ling et

al., 2008; Hornsby et al. 2009). Top-level managers are responsible for creating the conditions for carrying out initiatives that fall within the domain of strategic entrepreneurship (Hornsby, Kuratko,

Shepherd e Bott, 2009). At the same time, they are also responsible for structuring the organization in a way that facilitates the development of new entrepreneurial initiatives (Kuratko and Morris, 2018). However, it's through interactions and support of middle- level and first-level managers, they influence and shape the operationalization of the firm's corporate entrepreneurial strategy (Kuratko, Ireland, Covin, and Hornsby, 2005). Top management can instigate the strategy, but top management cannot dictate it (Kuratko, 2009), and a crucial role in the success or not of a Corporate Entrepreneurship strategy within an organization is at middle and lower ranks (Hornsby et al., 2009). In fact, without a strong and sustained commitment from all levels of the organization, entrepreneurial behavior will never be a defining characteristic of the organization (Kuratko, 2009). We can therefore conclude that, for the company to decide to pursue a CE approach in line with the goals of Context 5.0, senior managers need to adopt a new entrepreneurial posture and one that reflects values in which middle managers and first- level managers are also reflected, which are central for such a posture to become widespread throughout the company (Ireland et al., 2006). Here we can propose a new possible approach to define Corporate Entrepreneruship in line with Context 5.0: The Corporate Humane Entrepreneruship.

The need to rethink the concept of entrepreneurship has been addressed by the scientific community of management scholars which since 2016 (Kim, 2016) developed the concept of Humane Entrepreneurship (Parente et al., 2018; 2020; Kim et al., 2018; Vesci, 2018; Kim et al., 2021). HumEnt theory, expanding the Entrepreneurial Orientation theory advanced by Covin and Slevin (1989; 1990) and suggests a new entrepreneurial strategic posture (ESP), called Humane Entrepreneurial Orientation (HEO), defined by the integration of three dimensions: entrepreneurial orientation (EO), sustainability orientation (SO), and human resource orientation (HRO). Humane entrepreneurship is based on the idea that entrepreneurs should extend their priorities beyond their profit margin, toward their employees, people, environment, and society (Kim, 2016). HumEnt represents a new entrepreneurial strategic posture (ESP) that presupposes the pursuit of profit but considers it equally fundamental that the firm generates value by taking care of the interests of the environment, people, society in

general, and human resources. operating in the firm. Recently Parente et al. (2021) highlighted like Humane entrepreneurship can be a strategic approach to the development of Society 5.0 because shares with it the centrality of human value and achieves sustainability in a broad sense (Parente et al., 2021). Also, recently Kim et al. (2021), presented a model that demonstrates how Humane Entrepreneruship plays a role in the corporate/organizational entrepreneurship process.

According to the definition by Covin and Slevin (1991, p. 8), "Organizations with an entrepreneurial posture are those in which particular behavioural patterns are recurring." Therefore, for companies to decide to pursue a business approach in line with the needs of the 5.0 context through CE initiatives, they must adopt an entrepreneurial posture in line with the goals of the 5.0 context, we believe this can be the Humane Entrepreneurial Orientation, for several reasons.

- Humane Entrepreneurship build on the principle that entrepreneurs ought to broaden their focus beyond their financial goals, looking toward their employees, people, environment, and society's needs (Kim, 2016). Humane entrepreneurship can contribute to the development of a model of corporate entrepreneurship by emphasizing the importance of stakeholder engagement. This means adopting a stakeholder approach in the decision-making process and working with customers, suppliers, and local communities in the process to develop new solutions through CE initiatives. By doing so, companies can ensure that their activities are aligned with the real needs of all stakeholders, which can also help build trust and foster long-term relationships.
- As highlighted by Parente (2018), new digital technologies will contribute to making firms “houses of glass”, open to their consumers and stakeholders and in this sense, the companies will better adopt a kind of entrepreneurial strategies, also at the corporate entrepreneurship strategy level, that is in line with the guiding values of 'Context 5.0. And in this sense, Humane Entrepreneurship, enhances social responsibility either internally to the organization’s boundaries or externally to the organization’s boundaries, because at the same time through innovation aim to create value for the clients to “meet the needs of the present without compromising the ability of future generation to meet their own needs” (UN, 1987, Section 49).

- Many scholars have studied the relationship between Human Research Management activity and CE initiatives (Morris and Jones, 1993; Hornsby, Kuratko, and Montagno; 1999; Hayton et al., 2005; 2006; Montoro-Sánchez et al., 2011). One common thread in these studies of HRM practices and CE is the need for HR systems to support informal employee contributions, encourage cooperation, and avoid unnecessary bureaucratic constraints on behaviour (Hayton, 2005). How show the model developed by Kim et al. (2021), a model of CE based on Humane Entrepreneurship enhances organizational capital (human and social) and produces an innovative workplace culture based on enablement, empowerment, equity, and empathy.
- As highlighted by Carayannis (2022), the innovation process in complex environments should require the involvement of all players in the ecosystem, and this necessary openness fits well with the logic of Context 5.0 (Carayannis et al., 2022). Many studies have pointed out that the complexity of our time requires a systemic approach to innovation, which is based on the dynamics of relationships.

We believe that the open and systemic approach that characterizes the posture of Humane Entrepreneurship can well support an EC management that realizes the imperatives of the Quintuple Helix (Carayannis et al., 2022; 2023), which to date seems to be the best way to achieve the imperatives of "Context 5.0".

5 Conclusions

Starting from an analysis of the literature and policy briefs, in this paper, we analysed the common elements of the 'Industry 5.0' and 'Society 5.0' paradigms, arriving at an initial definition of Context 5.0. We focused on the challenges facing industries within Context 5.0. We highlighted how corporate entrepreneurship, especially Strategic entrepreneurship, can support companies to innovate and grow within Context 5.0.

In the last section, we analysed the theory of Humane Entrepreneurship, highlighting how the adoption of this entrepreneurial posture can support companies in adopting a CE strategy in line with Context 5.0 and facilitate integration with the Quintuple Helix approach, which seems to be the beacon to drive companies' innovation in the complex context of the 21st century. This study lacks empirical analysis, so the future research step is to verify through

empirical research whether and how this model their Corporate Humane Entrepreneurship is applied.

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Biophilic Architecture to Promote Environmentally Sustainable Behaviour in Children: The Project for the New School in Rionero in Vulture

Marco Laterza

Department of European and Mediterranean Cultures,
Environment, and Cultural Heritage
University of Basilicata
Via Lanera 20, 75100 Matera, Italy

Abstract

This paper aims to examine how biophilic architecture can be considered a key tool for promoting environmentally sustainable behaviour in children through the analysis of a case study. The first part expounds on the key principles of biophilia and the effects that a daily relationship with nature can generate on our mental and physical well-being. The paper explores the applications of biophilia in the field of architecture, as well as strategies to enhance the restorative experience that living spaces can have through the use of biophilic design.

The second part examines the case study of the project for the new secondary school in Rionero in Vulture, developed as part of the doctoral research on architecture and biophilia for the "Aree Interne"' of Basilicata, currently being carried out at the University of Basilicata. The project developed in collaboration with architect Matilde Suarez Ruiz, came out as the winner of the "Futura" design competition organised by the Italian Ministry of Education, applies design strategies based on the 14 patterns of biophilic design (Terrapin bright green, 2014) and on major environmental psychology theories such as Attention Restoration Theory (Kaplan, 1995) and Stress Recovery Theory (Ulrich, 1981). Through the use of biophilic design and restorative design strategies, the aim is to create spaces that help prevent attention deficit problems and learning disorders, promote psychophysical well-being and the development of eco-sustainable behaviour.

Finally, the third part of the paper will focus on the knowledge management process in architecture with special reference to the design competition system and the case study under consideration.

Keywords – Biophilic design, Restorative design, Eco-sustainable behaviour, Architectural knowledge management

Paper type – Practical Paper

1 Introduction

This paper aims to examine how biophilic architecture can be considered a key tool for promoting environmentally sustainable behaviour in children through the analysis of a case study. The first part will expound on the key principles of biophilia, its applications in architecture and related knowledge management and sharing systems.

The second part will examine the case study of the project for the new secondary school in Rionero in Vulture, developed as part of the doctoral research on architecture and biophilia for the "Aree Interne"[1] of Basilicata, currently being carried out at the University of Basilicata. The project developed in collaboration with architect Matilde Suarez Ruiz, came out as the winner of the "Futura" design competition organised by the Italian Ministry of Education.

Finally, the third part of the paper will focus on the knowledge management process in architecture with special reference to the design competition system and the case study taken into consideration.

2 The biophilia hypothesis

Biophilia literally means "love of life" and in a broader sense "love of all living things." The concept was popularised by entomologist Edward O. Wilson's 1984 book of the same name and is defined as the innate biological need of human beings to be connected to natural systems. In the same year, Roger S. Ulrich's famous publication "View through a window may influence recovery from surgery" appeared in the journal "Science," which suggested that a view of a natural environment in hospital patient rooms could have a restorative effect on patients. In research carried out in a Pennsylvania hospital between 1972 and 1981 in fact, Ulrich showed that for several patients undergoing the same type of surgery those who had a room with a view toward greenery had less need for pain medication and much shorter postoperative recovery times than patients who had a room with a view to a brick wall.

The possibility that contact with nature could have such powerful effects on our mental and physical well-being has generated a remarkable body of scientific experiments and demonstrations that have shown how constant and direct exposure to natural contexts has a decisive influence on our ability to concentrate, creativity, regulation of stress levels, blood pressure, and the

prevention and reduction of states of anxiety and depression. (Barbiero Berto, 2005. Barbiero and Berto, 2016. Harting, 2021)

In particular, two mutually complementary theories, the Stress Recovery Theory (SRT) developed by R.S. Ulrich and the Attention Restoration Theory (ART) elaborated by S. and R. Kaplan, show how contact with nature acts positively on the recovery of our cognitive abilities and well-being.

2.1 Biophilic Architecture

That the presence of trees, flowers, plants, water and natural materials in living spaces is a pleasant factor may seem almost taken for granted. But the studies cited in the previous paragraph show that daily contact with natural elements is not only pleasant but also necessary for our health.

"Seen as an amenity, nature can easily be replaced by any technological artifice. Seen as an essential link between human beings and the rest of the living world, natural environments have no substitute" (Kaplan and Kaplan, 1989).

Biophilic architecture is a field of study that seeks to systematise the application of biophilic findings to the design of inhabited spaces at all scales, from urban and landscape design to furniture objects. The research of Stephen Kellert and Terrapin Bright Green has explored the various possibilities of the relationship between the built environment and the natural environment (direct and non-direct connexion with nature, presence of water, biomimicry, presence of natural materials, fractal structures and patterns, connection with natural systems) identifying the beneficial and regenerative qualities for each of them (lowered blood pressure and heart rate, impact on cognitive performances, concentration and mental engagement, reduced systolic blood pressure and stress hormones, dopamine response, ...). The open source publication "14 patterns of biophilic design" (Terrapin Bright Green, 2014) translates the results of those researches in design strategies.

With reference to the educational context, a direct relationship between poor school outdoor environments and higher incidence of attention disorders has been demonstrated (Grahn et al., 1997). Wells (2000), on the other hand, showed that the same kind of impact is also caused by the quality of urban green space in the area of children's residence.

In 2019, a collaborative study between Craig Gaulden Davis, Morgan State University, The Salk Institute for Biological Studies and Terrapin Bright Green

presented comparative data collected in a biophilic classroom (views of natural environments, dynamic and diffuse daylight and biomorphic patterns) and a traditional control classroom. The results show a direct impact of biophilic design on students' and teachers' stress levels, concentration, and a marked improvement in students' academic performance. Among the research data, for example, it was found that 35% of students in the biophilic classroom perceived their stress to be high compared to 67% of students in the control classroom. Over a period of 7 months, the improvement in average maths test scores was more than 3 times higher in the biophilic classroom when compared to a control classroom (Determan et al., 2019).

2.2 Biophilic Architecture and Knowledge Management

The field of study of biophilic design presents a complexity due to the fact that it involves different disciplines such as architecture, ecology, neuroscience and environmental psychology. A proper classification and hierarchy of knowledge becomes very important for designers in order to share possibilities given by the applying biophilic design strategies. The 14 patterns are a very useful tool to facilitate the decision-making process for designers and the sharing of such choices with all stakeholders in the architecture process.

A series of studies made by Terrapin Bright Green between 2015 and 2017 created detailed case study sheets that analyse in the form of diagrams, graphs, and text the use of biophilic strategies implemented by selected best practices. Those open source studies are another key tool for designers to manage and share knowledge on biophilic design.

2.3 Relation between education, biophilia and environmentally sustainable behaviour

Policies put in place by national and supranational governmental structures show that environmental education (EE) and education for sustainable development (ESD) are the key elements in promoting sustainable behaviour.

The European Union published in 2022 a "European Nature Conservation Toolkit" designed especially for educators and children between the ages of 13 and 16. It is a tool created to share resources and tools to encourage discovery of nature in children: "letting students be inspired by their surroundings can be a

real first step to meaningfully engage them in respecting nature." Raising awareness of the issues of climate change and biodiversity loss involves gaining awareness and understanding of the natural environment, recognizing the importance of our behaviours toward nature, and understanding the impact of human activities on those changes.

Stimulating knowledge and respect for nature turns out to be of crucial importance to positively influence environmentally sustainable behaviours in children.

The relationship between biophilia and the development of eco-sustainable behaviours has been investigated by recent experimental experiences (Bellini 2021, Mancini, 2023) and Giuseppe Barbiero's research on the concept of "affective ecology". The latter is understood as a need to establish an emotional connection with nature in order to generate a deeper understanding of it and an attitude of respect :

"Knowing Nature is a necessary condition. But appreciating Nature - and appreciating ourselves in Nature - relates to the emotional sphere of the person. That is why it is necessary that alongside Cognitive Ecology, which is what I call the science of ecology with its epistemological status and theoretical corpus, there is also Affective Ecology, an ecology that educates the person to contact Nature, to immerse himself in it, finding there the energies that only a proper relationship with Nature allows to recover" (Barbiero 2011).

School represents one of the privileged environments for overcoming attitude behaviour gaps. In particular, during the secondary school period involving the age group of 11 to 14 years, the adolescent develops the cognitive structures of hypothetical-deductive thinking (Piaget, 1967) and, therefore, it represents a key stage for deepening and raising awareness of affective ecology.

The daily experience of a biophilic school then, by encouraging opportunities for daily contact with nature, becomes a decisive strategy in promoting environmentally sustainable behaviours. Indoor space, its relationship with the near and far environment, and the design of outdoor spaces as true "outdoor learning environments" can be thought of as part of the educational process toward eco-sustainable sensibilities.

These principles have driven the project for the new secondary school in Rionero in Vulture, winner of the "Futura" design competition organised by the Italian Ministry of Education. The project applies design strategies based on the

14 patterns of biophilic design and on major environmental psychology theories such as Attention Restoration Theory and Stress Recovery Theory.

3 The case study - A biophilic school in Rionero in Vulture

The project for the new secondary school in Rionero in Vulture proposes an innovative approach to the concept of a traditional educational space that involves the entire building in which to live, recognize oneself in a community, and reconnect with the surrounding natural environment.

The site where the new school will be built is set on a slight slope towards the "Fosso delle Fontanelle" with a privileged view of Mount Vulture, an extinct volcano that characterises the territory of the northern Basilicata region.

The location of the project site allows the design of spaces that generate a strong connection with the landscape-territorial values of the city of Rionero: Mount Vulture and the hydromineral resources represented by the Monticchio lakes and mineral water springs. The volume of the new building and the body of water in the entrance plaza create a duality intended to echo these values.

From the point of view of spatial insertion, the new architecture gives its back from the present provincial road upstream by using nature-based solutions for noise pollution shielding and opens to the landscape downstream.

The new urban arrangement defines a road system that organises parking spaces for vehicles, bicycles and buses and a square that will become the hub of relations between the new school and surroundings. The new square is designed to safely manage the entry and exit of students but also as a true protected and welcoming social space for the entire neighbourhood.

A second access on the north side facilitates use of the building outside school hours. A number of indoor (gymnasium, informal learning area, creative workshop) and outdoor (sports area and arena) spaces capable of hosting a range of activities, events, and meetings for the life of the neighbourhood have been placed in this area. To facilitate this kind of hybrid use this area of the school has a movable separation that allows it to be used independently from the rest of the learning spaces, and a plant system that can be used independently.

The school is not understood as a sum of classrooms but is extended and integrated into the social context.



General plan of the project.

3.1 Micro-city

The architectural layout of the new school is inspired by the traditional urban morphology of the area, which is rich in complex and diverse shared relationship spaces in order to let the genius loci of the city of Rionero breathe into the school environment.

Space is not defined by a concrete form but by the relationship between elements: full/empty, transparent/opacity, mineral/vegetal. Instead of a monolithic block, 5 interconnected volumes are proposed to open the school to the view of the surroundings and create a series of courtyards and patios that foster a constant relationship between the outside and the inside. This organic concept creates angles and curves that introduce shade, visual depth and a dynamic living experience.

The architecture fosters one of the fundamental principles for the development of children in this age group: the ability to manage their privacy by providing intimate spaces, passageways that encourage casual encounters, meeting points and gathering spaces.



Axonometric view of the project.

3.2 The school

If on an urban scale the building opens up to the neighbourhood, once inside the architecture becomes introverted, creating an interior world of interconnected spaces and secret gardens. The sequence of patios let natural light into the classrooms and views toward the gardens, making the space comfortable and familiar. The 5 main bodies organise the school into a play-educational area (extendable classrooms, laboratories, gymnasium, locker rooms) and services (entrance, administration, offices). Classroom spaces abandon the static concept of a frontal teaching setting in favour of a modular, adaptable and flexible space idea to foster dynamic and innovative learning processes.

Each classroom has a direct relationship with an appurtenant garden. This outdoor space is designed as an extension of outdoor educational activities to promote motor skills, ensure optimal radiation values and a daily relationship with the natural environment that help prevent learning and attention deficit disorders, promote psychophysical well-being and the development of eco-sustainable behaviour.

The proposal for the new school encourages a visual and physical connection with the natural elements through the interior gardens and views of the distant landscape: non-rhythmic sensory stimuli set the stage in the spaces for climatic and environmental variations (large windows to observe rain in the inner courtyards, spring sunshine, blossoms, falling tree leaves), dynamic and diffuse light present everywhere but in a filtered way to avoid glare and overheating of

the spaces, the presence of water that will also allow reconnection to the values of the hydromineral resources of the local landscape heritage.

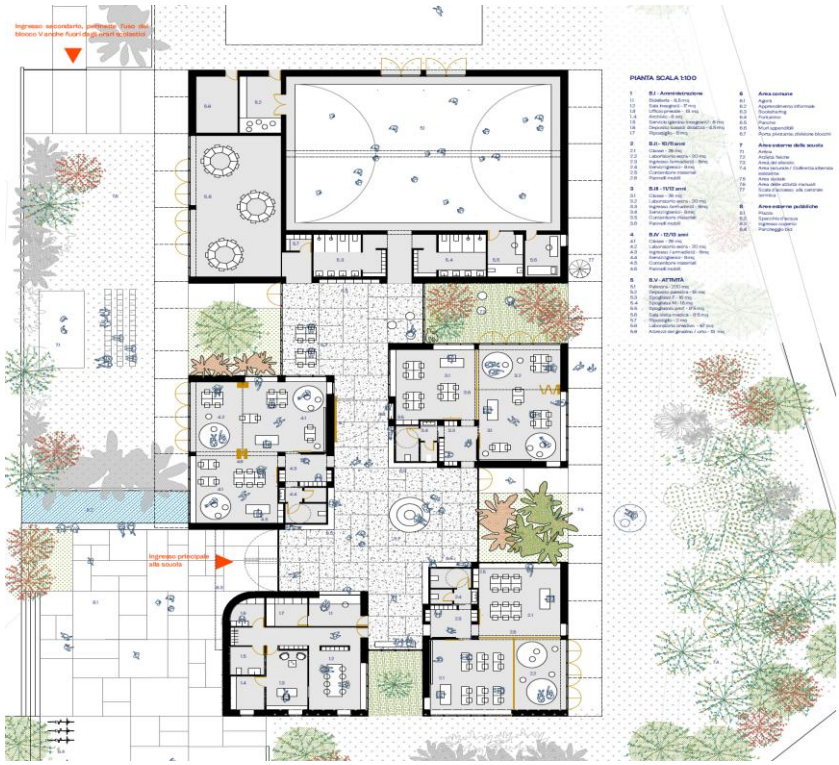
The common areas and the interior of the classrooms feature custom-made details and furniture made of FSC-certified wood, with a focus on spaces that encourage tactile and olfactory contact with the material such as benches, the booksharing library and fixtures.

Different natural cork-based materials will be used (screeds, plasters, interior finishes) from the supply chain of Italian industries that are experimenting with different applications of cork as a material that guarantees excellent qualitative performance as well as a significant reduction in the carbon footprint compared to the materials normally used in construction.

The same intentionality is also addressed to the outdoor areas. In addition to the gardens connected to each classroom the rest of the outdoor area is divided into 7 specific thematic areas with the specific task of fostering the correct development of the children's personalities by evoking, motivating and inspiring individual needs and requirements, and by raising asymmetric empathy and the development of eco-sensitivities:

- Manual activities area: to encourage craft activities and self-construction, customization and appropriation of school spaces, a key aspect of self-definition at this stage of development.
- Arena: for theatrical and musical activities, performances or simply outdoor gatherings on nice weather days. The latter two areas are deliberately in close proximity to the creative workshop to foster fruitful functional interference.
- Physical activities: to encourage the development of motor skills, designed in direct connection with the gymnasium and equipment storage.
- Silence area: for painting, reading and relaxing, near the informal learning area and booksharing area.
- Natural area: for moments of more direct contact with nature. They can be fostered by the creation of a vegetable garden or by gardening activities and raising awareness of environmental issues. Storage of garden materials is an indispensable support for these activities.
- Social area: a quiet area for conversation and interactions of children and teachers, an outdoor continuation of the “agora”.

- Sensory area: not a specific area but a focus on the design of indoor and outdoor spaces to encourage exploration and discovery through the senses with the integration of different native plant species, rain garden, and floor and wall materials with different textures (water, stone, wood, gravel, earth, grass).



Ground floor plan.

3.3 A school for the neighbourhood

The school's energy system not only serves as a demonstrator of good practice for the students and residents of Rionero in Vulture, but also lays the foundation for its subsequent development as the nucleus of an energy-conscious and self-sufficient community.

On the roof of the gymnasium, an area of about 150 square metres is planned for the installation of the photovoltaic system with a capacity of 20 kW, useful for meeting the needs of the entire building, the new electric car charging stations planned in the car park, and for lighting the outdoor areas. In addition, the

proposal for the new school suggest to the municipality of Rionero in Vulture a subsequent development of the project that, with a further investment, could equip the plant with storage batteries that would allow the new school to become the hub of an eco-sustainable energy community based on the sharing of resources and self-consumption.

The assessment of the climatic risk and vulnerability of this area of the Basilicata region leads one to argue that it is imperative to implement effective stormwater management strategies and rationalise the use of water resources and mitigate the runoff phenomena that cause frequent disasters due to flooding.

As an adaptation strategy to climate change, a system was designed to treat and manage first rainwater by creating a "rain garden": a feature formed by a slight depression in the ground covered by greenery that is very effective in managing meteorological runoff in a sustainable and natural way.

The recovery of rainwater falling on the roofs will make it possible to accumulate a water reserve in an underground cistern and, after suitable treatment, reuse it for drains, irrigation and the fire-fighting system tank.

The design choices are intended to convey a series of values to ensure that living in the school space is part of an educational process understood in a broad sense, extended to the entire local community. The architectural form becomes the tool for transmitting the pedagogical idea of a school open to the outside world and capable of generating and transmitting eco-sustainable behaviour and directing the choices and behaviour of the community that lives there on a daily basis.

4 Knowledge Management in Architecture

The last part of this paper aims to analyse the process of knowledge management in architecture and particularly with reference to the architectural competition system and the case study under consideration.

Architectural Design Decisions (ADDs) is recognized among the highly relevant knowledge management processes for which a system to classify and share the different stages of the decision-making process is very important (Tang et al., 2010). Comparative research has shown that several interesting experimental tools have been developed in the last decade but to date there are no tools on the market that support the Architectural Knowledge process (AK) (Capilla, 2021)

However, the procedure of selecting design ideas through design competitions presents a decision-making and methodological organisation by successive steps that is very interesting from the point of view of evaluation and sharing the knowledge management process.

4.1 Design competition and knowledge management

In January 2023, the "FUTURA - la scuola per l'Italia di domani" project promoted by the Ministry of Education - Mission Unit for the EU-funded PNRR (National Recovery and Resilience Plan) - Next Generation EU, selected 212 projects for innovative schools to be built by 2026. The case study of the new middle school in Rionero in Vulture presented here is part of this selection that took place through the procedure of "2-degree design competitions."

In architecture, design competitions represent a virtuous system in terms of the transparency of the decision-making process, possibility of access to public contracts, and fosters the development of innovative ideas through intellectual competitiveness. Moreover, in this case, they represent an effective strategy for transferring the sustainable development goals set by the European Community to the national and local authorities, to professionals and involved communities.

For the interest of the system of knowledge management and sharing between policymakers and stakeholders, the different steps that composed this process are briefly set out here.

An initial phase initiated by the ministry selected the 212 project sites, from among those nominated by local governments, that best aimed to meet the objectives of the ministry's "green revolution and ecological transition" plan for achieving goals such as sustainable resource and water use, circular economy, pollution reduction, and protection of biodiversity and ecosystems.

For each of these sites, the local authorities, in collaboration with school communities and stakeholders, produced a dossier containing surveys, geological studies and analyses of the buildings' functional, energy, structural, and educational supply needs. These dossiers, which were made available to all groups participating in the competition, had as one of their main objectives to make explicit the analysis of the programmatic alternatives that motivated the choice of either rehabilitating an existing school building or demolishing it by reconstructing it (as in the present case study).

With these starting data, the two-degree design competition was initiated. With the first degree, with open participation, the 5 best proposals were selected and were asked to further investigate the design ideas. Finally, the winner was asked for further elaboration through the preparation of a "technical and economic feasibility project" (PFTE). In this last phase, the architects further explicated urban and environmental insertion choices and compliance with the sustainable development objectives required by European directives: principle to Do Not Significant Harm (DNSH), Life Cycle Assessment (LCA), Carbon Footprint of the building and compliance with CAM (minimum environmental criteria).

From the first phase of selecting schools for funding to detailed project developments, this process has focused on the strategic goals of sustainability, combating and adapting to climate change by creating a sharing of intent and knowledge transfer from the macro political scale to detailed project choices. The impact on informing, educating and then promoting environmentally sustainable behaviour will be measured on future school users but has already involved a whole range of administrators, professionals and stakeholders.

The 5 ideas selected for each of the 212 sites represent a wealth of more than 1000 projects that share the common denominator of reflections on the theme of innovative sustainable and resilient schools. The exhibition and publication to be organised by the Ministry of Education will represent a huge compendium on the state of the art of school design in Italy. It would be very important to be able to return not only the graphic tables of the design ideas but all the studies and documents produced and the motivations expressed by the juries for each phase of the competition, including the selection of the project sites proposed by the local authorities. Indeed, this repository would become an enormously valuable tool for policymakers, stakeholders, and designers.

5 Conclusions

The studies examined in this paper show how biophilic design enables the design of spaces that promote people's psychophysical well-being. In addition, the experience of these types of spaces can be considered a formative process capable of raising users' awareness of respect for nature and ecosystems. This can be instrumental in encouraging the development of eco-sustainable behaviours.

Finally, emphasis was placed on how the selection of design proposals through the instrument of design competitions is the tool that allows the development

and sharing of innovative ideas and visions for the kind of society of the future that we want to build.

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What is Intercultural Competence and for Which Situations is it Necessary? Validation of the Content and Application Areas of a Test for Measuring General Intercultural Competence and Culture-Specific Competence

Petia Genkova*

Faculty of Business Management and Social Sciences
University of Applied Sciences Osnabrück
Caprivistr. 30 A, D-49076 Osnabrück

Christoph Daniel Schaefer

Faculty of Business Management and Social Sciences
University of Applied Sciences Osnabrück
Caprivistr. 30 A, D-49076 Osnabrück

Jonathan Herbst

Faculty of Business Management and Social Sciences
University of Applied Sciences Osnabrück
Caprivistr. 30 A, D-49076 Osnabrück

Henrik Schreiber

Faculty of Business Management and Social Sciences
University of Applied Sciences Osnabrück
Caprivistr. 30 A, D-49076 Osnabrück

** Corresponding author*

Abstract

Advancing globalisation processes entail that businesses increasingly have to orient themselves internationally in order to remain competitive. Growing labour mobility and international economic networks imply a rise in intercultural contacts, and thus a rising demand for intercultural competence. However, the relevance of intercultural competence is often underestimated outside of the academic community. In order to elucidate the significance, the necessity and areas of application of intercultural competence, an explorative (primarily qualitative) study was conducted with students and professionals

with and without a migration background. The central objects of study were the experience-based attitudes of students and professionals. In this qualitative study, 61 structured interviews were examined using a content analysis. After the presentation of a definition of the construct, the interviewees were asked about aspects of intercultural competence. The aspects mentioned most frequently was a general open attitude, followed by impartiality, self-reflection of one's own culture and person, and lastly, culture-specific knowledge. Regarding the areas in which intercultural competence is needed, respondents mentioned the education sector most frequently, followed by references to business, as well as internationally operating companies.
These results provided indications for the development of a measurement instrument of intercultural competence and related constructs. Therefore, another qualitative study was conducted with 249 interviewees to identify aspects of both, general intercultural competence, and culture-specific competence in a German cultural environment. Eleven dimensions of general intercultural competence, relating to personality traits, relational attitudes, and skills, were identified in a content analysis of the interviews. Further, six culture-specific aspects were derived from the interviews, containing culture-specific knowledge, norms, and communication skills. Based on the responses, three scales were generated: two graded response scales for general intercultural competence and culture-specific competence, and a culture-specific situational judgement test.
The resulting measuring instruments were thereafter validated in a quantitative study with a total of 6338 participants, including students, professionals, and unemployed, each with German background, international background, refugee background, or emigrated. The scales' and subscales' reliability and validity were tested in the individual subsamples, using methods from both classical test theory and item response theory. The items were reviewed twice, based on the calculated item characteristics, as well as on results from a focus group with immigrants and expert discussions.
The present paper thus contributes to a differentiated understanding of cross-cultural and culture-specific aspects of intercultural competence in an increasingly culturally diverse global society.

Keywords – intercultural competence, intercultural contact, specific intercultural competence, measuring intercultural competence, international cooperation

Paper type – Academic Research Paper

1 Theory

The significance of intercultural competence is increasing. Globalisation processes are advancing despite international crises, with a multitude of implications for living and working in the European Union. Intercultural competence, which refers to abilities to communicate and act effectively and appropriately in intercultural settings, is of pivotal importance for the cooperation between countries and cultures, as the different culturally determined ways of

thinking, feeling, and acting often inhibit efficient and effective collaboration and communication. Intercultural competences are of particular importance for international joint ventures, for example to cope with global challenges, such as the Corona pandemic or the current energy crisis. Furthermore, in view of international mobility and increasing economic linkages, intercultural competence plays a crucial role for businesses, as teams that work together, as well as management positions, are increasing in cultural diversity in European countries, and multinational collaborations are specifically supported within the EU.

For measuring intercultural competence, several models exist, some of which were created within the humanities as early as the 1980s (during the Cold War) (Deardorff, 2009; Genkova, 2019). However, many models lack a clear differentiation from other constructs (Schnabel et al., 2015). Newer psychological measurement instruments have a higher construct validity, but many of them were developed only in specific cultural settings. Therefore, the validity of these instruments in other cultures cannot be presupposed. Established measurement instruments, such as the Multicultural Personality Questionnaire (MPQ, van Oudenhoven & van der Zee, 2000) or the Cultural Intelligence Scale (CQS, van Dyne et al., 2009), defined intercultural competence as a specification of established concepts, namely intelligence and personality, yet fail to map intercultural competence holistically. Furthermore, the mentioned scales showed low reliabilities in other cultures in some cases. Additionally, there was evidence of measurement invariance, suggesting that not the same construct was measured in different cultural contexts (Genkova and Schreiber, 2019, 2021; Genkova, Schreiber, and Gäde, 2021; Genkova, Schreiber, and Schneider, 2021; Schnabel et al., 2015).

2 Research Question and Method

Due to the mentioned dependence on cultural contexts and areas of application, three studies were designed.

A first explorative qualitative study (Study 1) was conducted among 61 students and professionals with German and migration background to assess cross-cultural and culture-specific aspects of intercultural competence, as well as areas, in which intercultural competence is deemed necessary.

Based on the results of this study, a model was developed which separates a general, cross-cultural intercultural competence from a culture-specific

competence – analogous to the model of a general and a specific intelligence. Based on this model, two more studies were designed to explore how intercultural competence can be operationalized, so that it encompasses both general, cross-cultural aspects and culture-specific competence: A qualitative study (Study 2) aimed to identify dimensions of general intercultural competence and culture-specific competence, and to generate hypothesis regarding the conceptualization and operationalization of intercultural competence. A quantitative study (Study 3) contained the generation, revision, and validation of a scale to measure general intercultural competence and culture-specific competence.

Study 1: In the first study, 61 structured interviews were used and examined by means of content analysis according to Mayring (2019). In order to define intercultural competence for the interviewees, the definitional consequence of intercultural competence, namely the ability to communicate appropriately and successfully with people from other cultures, was presented to the interviewees. Then, the interviewees were asked about aspects of intercultural competence, and areas in which they see intercultural competence as necessary.

Study 2: In the second qualitative study, 249 semi-structured interviews were conducted with people from eight target groups (students, employees, unemployed people, and experts who work with interculturality; each group consisting of one national subgroup and one subgroup with migration background). Among other, the study investigated what is understood by intercultural competence and in which situations intercultural competence is needed. In addition, the distinction from similar constructs, such as social competence, communicative competence and culture-bound competence, was examined.

Study 3: A quantitative study was conducted among a total of 6338 participants, including students, professionals, and unemployed, each with German background, international background, refugee background, or emigrated. The aim of Study 3 was to review the items, to test the construct, the aspects and the items for generalizability across different cultural backgrounds, to verify the defined model, and to test the generated scale's reliability and validity.

The development of an instrument for measuring culture-specific German competence aspects enables the later examination and promotion of the competence status (with regard to the German culture) of individuals who did not grow up in Germany. (For these individuals, the designation "internationals" was

ultimately used, as very strong latent and explicit concerns about other designations emerged during the interviews. The term internationals proved to be a useful term to group together people with a migration background, expatriates, international students and people who recently immigrated, as, for example, refugees, or foreign employees, while avoiding negative meanings, such as stigmatization).

3 Results of the Qualitative Studies

Study 1: Asked about aspects of intercultural competence, the interviewees most frequently mentioned a general open attitude (approx. 85% of the interviewees referred to it), which interviewees partially associated with an interest in other people and cultures. About 44% of the participants referred to impartiality, including the act of consciously putting aside one's own prejudices. About one third of the respondents described self-reflection of their own culture and person as a further aspect of intercultural competence, thus addressing an aspect that is rather rarely found in the research literature. Beyond these and further cross-cultural aspects of intercultural competence, more than half of the respondents referred to culture-specific knowledge.

Regarding the areas in which intercultural competence is needed, respondents mention the education sector most frequently (approx. 70%), followed by references to business (approx. 42%; including HR departments and marketing), as well as internationally operating companies (approx. 26%). The breadth of these results has high heuristic value. On the one hand, surveying the prevalence of certain understandings of intercultural competence makes it possible to examine the fit between an experience-based everyday understanding and a scientific definition of intercultural competence. On the other hand, aspects mentioned by the respondents provide relevant insights into the necessary width of the desired scientific definition of intercultural competence. These results provide important indications for the development of measurement instruments of intercultural competence, as well as for constructs that should be correlated with intercultural competence.

The second qualitative study was conducted among 249 students, professionals, and unemployed, with German and international background. A qualitative content analysis (Mayring, 2019) was used to create a large number of categories that reflect aspects of intercultural competence. The categories under

which most of the aspects (mentioned by participants) were subsumed, were, for general intercultural competence:

- Personality traits: openness, agreeableness, and extraversion.
- Relational attitudes: lack of prejudice / equal treatment, understanding, tolerance, acceptance, respect, (active) listening, helpfulness, perspective taking, patience and reflection
- Skills: communication skills, adaptability, empathy, flexibility, conflict handling skills, and sensitivity.

For culture-specific competence, the categories under which most of the aspects mentioned by participants were subsumed, were:

Knowledge of foreign languages, knowledge about cultural specificities, food habits and table manners, punctuality, religion, clothing, work ethic, being organised, customs, rules and laws, types of communication, direct versus indirect communication, and speaking volume.

4 Results of the Quantitative Study and Discussion

Based on these categories, a research team of experts generated items for a questionnaire. From these, several items were selected after expert evaluations. The selected items operationalised cognitive, affective, and conative aspects of intercultural competence. Reversed items (for which agreement with a statement corresponds to a low expression of the construct) were also created, to counteract response biases. In the next phase of the study, the measurement characteristics of the items were tested, using different samples. These samples were: international students, students without migration background, students with migration background, expatriates, refugees, employees, unemployed people. As a result of these analyses and revisions, 214 items were retained.

The items for surveying general intercultural competence were assigned to the following dimensions, on the basis of statistical and content fit:

- Interest in other cultures
- Openness to people from different backgrounds
- Agreeableness (incl. active listening and responsiveness to others)
- The ability to deal with conflict
- Empathy, perspective taking
- Respect, tolerance
- Flexibility

- Reflection on own and other cultures
- Ambiguity tolerance
- Self-confidence
- Extraversion

For the items surveying culture-specific competence, the following dimensions were formed, on the basis of statistical and content fit:

- Structure and formalities
- Laws and customs
- Manners, conviviality, and values
- Forms of communication, including German language skills
- Punctuality and time management
- Equal rights for women and men

As an additional way to measure culture-specific competence, a Situational Judgment Test consisting of 37 items was generated.

The quantitative study was conducted to verify the scales regarding the measured construct, the identified dimensions, and the generated items, and included methods from classical test theory (KTT) and item response theory (IRT).

The separation of culture-specific competence from general intercultural competence was supported by exploratory factor analyses and multidimensional scaling on item and dimension level. Correlation analyses including the generated scale, as well as the MPQ, CQS, the test for measuring intercultural skills (TMIKS, Schnabel et al., 2015), and the sociocultural adaptation scale (SCAS, Ward & Kennedy, 1999), confirmed the scales' construct validity. The values are shown in table 1.

Table 1: Bivariate correlations of scales for intercultural competence

		1	2	3	4	5	6
1	General		.606**	.616**	.686**	.560**	.427**
2	Culture-specific			.349*	.467**	.336*	.240
3	TMIKS				.630**	.621**	.513**
4	MPQ					.560**	.480**
5	CQS						.610**
6	SCAS						

Comments: ** $p < .01$, * $p < .05$.

The effects were controlled for demographical data, as well as for participants' international experience, quality and quantity of intercultural contact, language skills, and cultural distance.

Cronbach's Alpha was calculated to determine the scales' and dimensions' reliability, for each sample. The subscales showed acceptable Cronbach's Alpha values (ranging from .65 to .97).

Differential item functioning (DIF) tests were conducted to examine whether the items were generalizable across cultural groups. For the general intercultural scale, DIF was calculated for the group factors German – International, and for the culture-specific competence scale, DIF tests were conducted for comparisons between refugees and non-refugees, between immigrants that stayed more and less than two years in Germany, and between the different cultural groups with which the international participants were affiliated. To further verify item generalizability, KTT item characteristics mean-based difficulty, item-subscale-correlation, item-total scale-correlation, and monofactorial EFA score were correlated for the different samples included (students, professionals, unemployed; German and international each). Likewise, the situational judgement test was analysed and reviewed by conducting DIF, by calculating item difficulty and discrimination parameter, and graphical model checks.

After the revision of the scale, the remaining items all showed mean-based item difficulties between 20 and 80, item-subscale-reliabilities > .3, and their deletion did not raise Cronbach's Alpha (for critical cut-off-values of the item characteristics, see Moosbrugger & Kevala, 2012). Further, all remaining items had significant contribution to the respective dimension in monofactorial CFAs. A few items were tagged for DIF, yet showed functionality in the graphical check of the item response functions in the subsamples.

Furthermore, post-hoc analyses were conducted to identify effects on intercultural competence that need to be considered in individual diagnostics. Substantial effects were found for occupational status (studying – working – unemployed), and sex. The measurement instrument is currently further examined and standardized, based on large samples of different populations. The further examinations include tests of the extent to which intercultural competence aspects are statistically normally distributed.

In summary, our results suggest that general intercultural competence and culture-specific competence should be assessed separately. The aspects of general intercultural competence and culture-specific competence substantially

contribute to measure the respective construct. The initial version of the generated instrument in the German language proved generalizable among German speaking groups, regardless of their cultural background or migration history, and was found to be a reliable and valid instrument to measure intercultural competence. The module structure of the test suggests the development of further culture-specific scales that can be combined with the general intercultural competence scale. The feedback from both Germans and internationals in both the qualitative studies on the separation of culture-specific competence from general intercultural competence was positive. This separation was perceived as innovative, since something comparable has not yet been constructed.

Finally, intercultural competence continues to gain importance in the current times of crisis and due to increasing globalisation. Thus, a differentiated and validated measurement of intercultural competence – which separates general intercultural competence from aspects that are culturally specific – is highly relevant for its promotion and evaluation. The project presented here contributes to this important endeavour.

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Overcoming Organizational Tensions in a Knowledge Way: The Experience of Smart Working in the Public Sector - A New Way of Conceiving and Using Technology

Lucio Todisco*

Department of Economics, Management, Institutions
University of Naples Federico II
Via Cinthia, 21, CU di Monte Sant'Angelo, 80126, Naples, Italy

Giuseppe Modarelli

Department of Management
University of Turin
C.so Unione Sovietica 218-bis, 10136, Turin, Italy

Gianluigi Mangia

Department of Economics, Management, Institutions
University of Naples Federico II
Via Cinthia, 21, CU di Monte Sant'Angelo, 80126, Naples, Italy

Christian Rainero

Department of Management
University of Turin
C.so Unione Sovietica 218-bis 10136, Turin, Italy.

Paolo Canonico

Department of Economics, Management, Institutions
University of Naples Federico II
Via Cinthia, 21, CU di Monte Sant'Angelo, 80126, Naples, Italy

** Corresponding author*

Abstract

The pandemic emergency due to Covid-19 represented a relevant exogenous shock that profoundly changed people's work activities and social lives. The pandemic emergency made it possible to take a new and different view of the possibility of replacing traditional forms of work with more innovative ways of working linked to technological tools (Briggs et al., 2021; Bolisani et al., 2020; Foss, 2020). This has also been made possible by the significant digital transformations of the last decades.

Indeed, the role played by new technologies has been crucial during the pandemic, accelerating the ongoing trend towards the developed forms of work that make remote working easier: one of these is smart working (Todisco et al.,2022; Yarberry & Sims, 2021; Rainero & Modarelli, 2020).

Smart working, however, differs from traditional ways of working not only in the way it is carried out, which is not constrained by defined time and space limits in the performance of the tasks assigned to employees, but also in the different approach by which the organization is designed, linked to projects and objectives, and on how human resources are managed (Bednar & Welch, 2020; Torre & Sarti, 2019; Ellerton, 2015).

Several authors have identified three key dimensions of analysis for the diffusion and implementation of smart working: (1) the technological factor; (2) the redesign of physical spaces (3) a new vision of Human Resources in the organization. In addition to the three dimensions identified, other aspects must be considered to understand whether its deployment in the organization is taking place effectively. The first factor identified is the employee acceptance of this change in working methods and, therefore, the shift towards a more fluid and goal-oriented organization (Rainero & Modarelli, 2021). For example, the spread of smart working during the pandemic represented an essential change for the public sector, as well as an opportunity to implement those reform paths that have redesigned public administration in recent decades to make it more effective and efficient (Pollitt & Bouckaert, 2011; Tomo, 2018).

The other factor identified is employees' willingness to accept new technologies (Bunker, 2020; Jämsen et al., 2022) and the effective one of digital platforms (Agostino et al., 2021).

As mentioned above, smart working represents a significant opportunity for change in public administration. While on the one hand, it represents an opportunity to guarantee the delivery of services to citizens (Edelmann et al., 2021), on the other hand, it could be critical in several aspects, opening windows of reflection on the impacts this way of remote working could demonstrate affecting employees' lives. Having to deal with such a disruptive change and the impact of technology on employees' lives has challenged certain aspects, such as planning, assigning tasks, and holding meetings that allow people to share and create organizational knowledge. These aspects of smart working represent a significant challenge for public managers, whose main task is to finalize the creation and management of knowledge.

This research aims to evaluate and highlight the architecture of established working behaviours and practices based on the change in the working model imposed by the pandemic emergency in the public sector. So, the research investigates how smart working, and its impacts alter the processes of sharing organizational knowledge, according to the introduction and application of technologies in the working life of public employees. After the intervention of an exogenous shock, such as the pandemic, the related availability,

perceived usefulness, and ease of use can change considerably in this regard. Starting from the Technology Acceptance Model (TAM) and, in parallel, the Theory of Planned Behaviour (TPB), the authors intend to interpret reality through the lens of multifaceted aspects, reasoning in detail by a perspective based on complexity and non-linearity featured periods. Specifically, the authors investigate: i) how the perception of the use of digital tools in the workplace has changed from the pre-pandemic to the post-pandemic period in the public sector ii) how and in which way digital tools continued to be used after the critical phase of the Covid-19 health emergency.

Keywords – Knowledge Management, Digital Transformation, Organizational tensions, Smart Working, Public Sector

Paper type – Practical Paper

1 Introduction

The pandemic emergency due to Covid-19 represented a relevant exogenous shock that profoundly changed people's work activities and social lives. The pandemic emergency made it possible to take a new and different view of the possibility of replacing traditional forms of work with more innovative ways of working linked to technological tools (Briggs *et al*., 2021; Bolisani *et al*., 2020; Foss, 2020). This has also been made possible by the significant digital transformations of the last decades.

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Smart working, however, differs from traditional ways of working not only in the way it is carried out, which is not constrained by defined time and space limits in the performance of the tasks assigned to employees, but also in the different approach by which the organization is designed, linked to projects and objectives, and on how human resources are managed (Bednar & Welch, 2020; Torre & Sarti, 2019; Ellerton, 2015).

Several authors have identified three key dimensions of analysis for the diffusion and implementation of smart working: (1) the technological factor; (2) the redesign of physical spaces (3) a new vision of Human Resources in the organization. In addition to the three dimensions identified, other aspects must be considered to understand whether its deployment in the organization is taking

place effectively. The first factor identified is the employee acceptance of this change in working methods and, therefore, the shift towards a more fluid and goal-oriented organization (Rainero & Modarelli, 2021). For example, the spread of smart working during the pandemic represented an essential change for the public sector, as well as an opportunity to implement those reform paths that have redesigned public administration in recent decades to make it more effective and efficient (Pollitt & Bouckaert, 2011; Tomo, 2018).

The other factor identified is employees' willingness to accept new technologies (Bunker, 2020; Jämsen *et al.*, 2022) and the effective one of digital platforms (Agostino *et al.*, 2021). This aspect is particularly relevant since the relationship between individuals and technologies enables effective knowledge management within an organization to support projects' sustainability. As mentioned above, smart working represents a significant opportunity for change in public administration. While on the one hand, it represents an opportunity to guarantee the delivery of services to citizens (Edelmann *et al.*, 2021), on the other hand, it could be critical in several aspects, opening windows of reflection on the impacts this way of remote working could demonstrate affecting employees' lives. Having to deal with such a disruptive change and the impact of technology on employees' lives has challenged certain aspects, such as planning, assigning tasks, and holding meetings that allow people to share and create organizational knowledge. These aspects of smart working represent a significant challenge for public managers, whose main task is to finalize the creation and management of knowledge.

This research aims to evaluate and highlight the architecture of established working behaviors and practices based on the change in the working model imposed by the pandemic emergency in the public sector. So, the research investigates how smart working, and its impacts alter the processes of sharing organizational knowledge, according to the introduction and application of technologies in the working life of public employees. After the intervention of an exogenous shock, such as the pandemic, the related availability, perceived usefulness, and ease of use can change considerably in this regard. Starting from the Technology Acceptance Model (TAM) and, in parallel, the Theory of Planned Behaviour (TPB), the authors intend to interpret reality through the lens of multifaceted aspects, reasoning in detail by a perspective based on complexity and non-linearity featured periods. Specifically, the authors investigate: *i) how the perception of the use of digital tools in the workplace has changed from the pre-*

pandemic to the post-pandemic period in the public sector ii) how and in which way digital tools continued to be used after the critical phase of the Covid-19 health emergency. The authors submitted to ten public managers at a local level in the Italian context a series of semi-structured questions originated by the TAM. The aim is to verify and provide valuable insights into some particularly relevant aspects of the knowledge dissemination and sustainability of projects in the public sector, evidencing a virtuous cycle that emerged from a need, framed by knowledge, and solved by a strategical view based on this latter. Primarily, the authors' intention moved from the objective to understanding how public managers' motivation and working habits have changed under the lens of complexity and urgency due to the impact of the adoption of new technologies for web-mediated work environments. In this, change is perceived as a tension-generating shock, and the social and organizational community tends to refute that, particularly in the public sector. Secondly, the authors aim to answer the question related to the perception and the use persistence of digital tools within the working environment during the post-pandemic period (after the emergency as a structured practice).

In this way, TAM vehiculated by a knowledge strategy for acceptance, triggered by the urgency sentiments and the readiness of a technology functional to a relatively neglected way of work (tele/agile/smart working), would reserve and demonstrate surprising and unexpected results in terms of willingness to remain in this operational frame, despite a regulatory modulation recently emerged at the end of the health risk.

The perceived usefulness (mediated by the urgency sentiments) and ease of use (mediated by the readiness of technology and web-mediated collaborative platforms), structured habits based on a highly positive perception based on these variables able to go beyond the state of emergency and reticence inherent the sector (Cinar *et al*., 2019).

2 The new ways of work in the "New Normal" era

Over the last few decades, the topic of new ways of working brought about by new technologies has become central to the organizational debate (Appelbaum, 2013; Engeström, 2004). These new forms of work should be seen in the context of profound social transformations in which technologies have changed relationships and shared values. According to Jackson (2021), these

transformations have led contemporary society toward the destruction of society's archaic values in terms of mutual social and economic balance (Rainero & Modarelli, 2021). In this context of profound change, new technologies modify the relationship between humans and organizations on a double level: a broader one that concerns the human-machine-society relationship; and a second level where people's work is involved in the human-organization-human-machine-society relationship (Bahri *et al.*, 2021). Teleworking is one of the first new ways of working that have spread related to the use of technology. Teleworking represents a technology-supported organization of work that allows people to work from home. Teleworking has also been dubbed "working from *home.*" These changes considerably impact people's lives and their way of working and being in society, significantly impacting motivation and happiness (Layard, 2011). Therefore, to build a society with as much happiness and as little unhappiness as possible, there can only be a new balance in society through the dissemination of knowledge dictated by new technologies. This factor assumes a central role in a period such as the current one in which rapid digital transition has occurred. This historical phase has seen generalized access to knowledge with the advent of the Internet and new enabling technologies (Delany, 2022). At the same time, however, following the Covid-19 pandemic, this digital transformation path meant that individuals had to quickly accept new technologies to adapt to new ways of working. For this reason, the issue of knowledge in organizations, which is closely linked to the effective use of new technologies since the 'New Normal,' is a more complex and challenging exercise than we have observed recently in economies characterized by structural optimism and constant underestimation of risks. Moreover, the diffusion of knowledge within organizations can only pass through accepting new technologies. Starting from these assumptions, the authors intend to focus on one of the new ways of working, smart working, considering different temporal phases of investigation: a) pre-pandemic, b) during the pandemic, c) after the pandemic). In *detail*, the authors focus on the public sector, where the use of smart working before the pandemic was marginal compared to face-to-face work. This is useful from an academic perspective to identify the speed of acceptance of technology use and change within an organization. In this regard, through semi-structured interviews with ten public employees in organizational positions in the Italian local public administration, a preliminary analysis of the acceptance of the digital transition and the reduction of reluctance to change is proposed for the public sector in terms of the

application of the FKTKS (Rainero & Modarelli, 2021), especially in the presence of complexity, non-linearity, uncertainty and unpredictable exogenous shocks such as the Covid-19 pandemic.

3 A new form of work: the smart working

Over the past decades, numerous exogenous events have impacted environments and negatively affected the social life of individuals. As in the case of the pandemic emergency of February 2020, epidemics and pandemics must be considered an event belonging to exogenous events that are impossible to predict. During the most critical phases of its spread, Covid-19 made it challenging to carry out office activities in presence, paralyzing society on an individual and organizational level (Alipur *et al.,* 2021; Bolisani et al., 2020). The pandemic emergency, as mentioned above, changed several aspects of work organization and individual work patterns. Most work activities have shifted to remote (Oosthuizen 2022; Todisco *et al.*, 2023). The pandemic has favoured overcoming work performance predominantly in presence, favouring work logic linked to the Bring Your Own Device (BYOD) strategy (Papagiannidis *et al.*,2020).

Technology has played a crucial role in responding to the need to continue to operate and ensure the smooth running of work activities and services to users. Added to this has been the need to frame and understand the phenomena of technological acceptance by employees in support of new ways of conducting remote work linked to new technologies (Rainero & Modarelli, 2020). In this scenario of change in working methods, a way of carrying out work that goes by smart working has found diffusion. According to several authors (Gastaldi *et al.*, 2014; Hu, 2020), smart working is a mode of work performance based on broad autonomy in the choice of time and place of work to improve individual well-being and organizational efficiency. Usually, the spread and implementation of smart working take place around three key dimensions: (*1) the technological factor; (2) the redesign of physical spaces, and (3) a new vision of Human Resources in the organization*.

The first dimension of the smart working analysis is the effective use of digital technologies to support work activities. The development of new digital platforms and increasingly high-performance technologies has enabled workers to do their work more effectively and efficiently. In the past, several authors have pointed out how new technologies positively impact employees' productivity and well-being.

On the other hand, the spread of smart working during the pandemic emergency has also drawn attention to other aspects, namely how technologies can increase the feeling of isolation and work overload, neutralizing the benefits of smart working.

Over the years, therefore, attempts have been made to structure different models to address best the application of smart working, implementing appropriate standards to obtain the benefits of this new way of working (Lake, 2016). The second dimension of analysis related to smart working concerns redesigning the workplace. The shift to flexible organizational structures has changed the traditional concept of the 'workplace' (Yang *et al.*, 2023). Smart working means redesigning physical spaces and reconfiguring the impact of physical spaces on employees and economic and environmental sustainability. It represents an organizational upheaval of people's relationship with workplaces, impacting individual well-being and the meaningfulness of the concept of work itself (Dingel & Neiman, 2020). Finally, smart working can only be realized if cultural and managerial approaches to human resources management are redefined. The role of management in this aspect is crucial because smart working is only possible with an increased focus on the growth of professionals in both specialized knowledge and skills and in transversal and relational skills (Brunetto & Beattie, 2020). With the new technologies available, discussing the development and spread of smart working is possible. The use of technology can be viewed from two different perspectives: On the one hand, it facilitates real-time interactions between employees, which impacts the meaningfulness of work.

On the other hand, the use of new technologies redefines the processes of knowledge diffusion through new technologies, which, if well used, help people and companies to increase efficiency and reduce the impact of presence in the workplace.

4 Research design and context

4.1 Theoretical framework: the technology acceptance to improve knowledge diffusion in organizations.

The following work-in-progress paper takes the opportunity to understand the acceptance of technology from a knowledge diffusion perspective. The authors refer to a theoretical framework complemented by the strategic view TAM and

FKTK considered to define and shape the way human beings (through social factors, psychological elements, and individual qualities) consider choices and decisions. The choice falls on q for two reasons: the technological dimension is pervasive in social life and ready to be widely applicable to work.

In this sense, perceived usefulness and ease of use would be verified (TAM-validated variables). In this direction, the influence of media and urgency, combined with the managerial perspective and the individual's ability to create knowledge, can foster knowledge creation (self-induced, internally, or externally induced), validating the objectives of the FKTK strategy. In this sense, the urgency represented by the development of Covid-19, the intention/motivation (Bunker, 2020) to deal with the emergency shifted subjective norms and individual control based on personal/collective readiness to use technologies (attitude) toward the behavioural acceptance of changing work habits in a socially organized and generalized manner.

4.2 Context

The context chosen was that of the Italian public administration, where smart working represented a significant novelty during the pandemic. The Italian regulatory framework on smart working was defined by law no. 124/2015 (art. 14), as well as by the law n. 81/2017 (articles 18-24) Regarding the Italian public sector, the Directive of the Presidency of the Council of Ministers DL n. 3/2017, which has begun to outline the regulatory framework and the behaviours to be identified for smart working in the Italian public administration. With the first pandemic wave of March 2020, a sudden transposition of work activities into smart working became necessary. Therefore, with the DPCM of 1 March 2020, a simplified implementation procedure was introduced, which remained in force until 31 August 2022. Finally, with the law n.122/2022, which converted the D.L. 73/2022, there has been a further change to the legislation on smart working. Smart working, therefore, for the public sector, represented during and after the pandemic an opportunity for a significant change compared to the old organizational paradigms, both from the point of view of managerial choices for the management and dissemination of knowledge and from the point of view of the use of technologies.

4.3 Sample

To analyse the acceptance of technologies and the diffusion of knowledge among workers, ten public employees were chosen for this work-in-progress paper as a sample who underwent managerial training on digital transformation issues within a university in southern Italy and who cover organizational positions within their public administrations (table 1). The sample was chosen because these figures, in the context of the Italian public administration, represent figures with managerial skills and the possibility of intervening in disseminating knowledge. The chosen methodology was to apply the TAM model to semi-structured interviews to go deeper into the issue of technology acceptance and knowledge dissemination. In particular, the interviewees were asked ten questions on the use of new technologies, their acceptance, and whether new technologies have allowed a wider diffusion of knowledge before, during, and after the pandemic emergency.

The interviews lasted from 25-30 minutes, and an attempt was made to develop a discussion during the interview on subjects that seemed of greater interest.

Table 1. Overview of participants to the study.

ID	Age	Gender	Education	Public Administration	Length of service
1	29-39	F	Master's degree	Fiscal Agency/Social Insurance Institute	< 5 years
2	>51	M	Master's degree	Fiscal Agency/Social Insurance Institute	> 20 years
3	>51	M	Master's degree	Fiscal Agency/Social Insurance Institute	> 20 years
4	29-39	F	Master's degree	Local Administration	< 5 years
5	40-50	F	Executive Master or PhD	Local Administration	> 20 years
6	40-50	M	Master's degree	Local Administration	> 20 years
7	40-50	F	Executive Master or PhD	Local Administration	> 20 years
8	40-50	F	Master's degree	Fiscal Agency/Social Insurance Institute	> 20 years
9	29-39	F	Master's degree	Fiscal Agency/Social Insurance Institute	> 20 years
10	>51	M	Executive Master or PhD	Fiscal Agency/Social Insurance Institute	> 20 years

5 Findings and Conclusions

The interviews demonstrated how the topic of acceptance of new technologies was susceptible for the interviewees. This acceptance has allowed for greater work efficiency. One of the interviewees stated:

> "*With the new technologies, both from the point of view of internal technical procedures and the interaction between colleagues, I have improved my work efficiency. I made work activities at home easier than in the office. (participant #2)*

Furthermore, the issue of acceptance of technologies is closely connected to a necessary understanding of their use in smart working.

> "*I do not have a particular aptitude for using technologies, but I do it with a view to improvement. It is not a loving relationship, but I know what I need work-wise. I often need a site technician in case of problems that other users might be able to solve on their own.*" *(participant #1)*

Another aspect of particular interest is tensioning towards knowledge through a more effective acceptance of technologies. One of the interviewees says that:

> "*Technologies have been an important tool to broaden skills during the pandemic and improve understanding of the tasks assigned while I was in smart working.*" *(participant #8)*

Furthermore, the last three years (2020-2022) have represented a significant social change for workers. This has necessitated adaptation to new technologies to deal effectively with work performance. Just as the necessary diffusion of practical knowledge to understand its use can break down the levels of reticence and resistance to change by pushing workers towards using technology in offices in a perspective of diffusion of knowledge in a perspective of collective learning (Butera, 2017; 2015).

> "*Technologies have allowed me a greater possibility of interaction with colleagues, and I have been able to develop work activities remotely with greater ease.*" *(participant #3)*
>
> "*Before the pandemic, smart working was not a viable way of working. We saw it as the only possible way during the pandemic and currently. However, it is good, thanks to the greater awareness of using new technologies. I prefer it over to the office because exchanging more information can give interaction and problem-solving possibilities.*" *(participant #5)*

"*The exchange of information was greater during and after the pandemic than in the past. Smart working, from my point of view, has helped this diffusion a lot.*" *(participant #7)*

From a managerial point of view, the interviews may be of interest for developing a broader research activity on disseminating knowledge in the public sector. The employees interviewed, being figures of middle managers concerning the main proposed QRs, represent professional figures of particular interest through an analysis of the changes that have occurred in their lifestyles and concerning how they understand the acceptance of technologies in their styles of work through a retrospective perspective, also considering the previous and subsequent perceptions related to the critical period under study, they can provide helpful insights into how the public sector is responding to the challenges of technological changes and the diffusion of knowledge through new technologies. Finally, from a theoretical point of view in this working-in-progress-paper, the TAM conveyed by a cognitive strategy of acceptance, triggered by feelings of urgency and by the readiness of a technology functional to a relatively neglected way of working (smart working), leads to interesting results, intending to transpose a qualitative use of this framework.

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Assessment of Knowledge, Attitude and Practice of University Students towards Sustainable Development Goals (SDG's) in Tanzania

Mrigo Shamimu Nyamota*

Department of International Program for Sustainable Development
Chang Jung Christian University
No. 1, Changda Rd., Gueiren District, Tainan City
711301, Taiwan (R.O.C.)

Alfred Jubilate Ngowo

Department of Diagnostic Medicine
Muhimbili University of Health and Allied Sciences
P.O Box 65001 Dar es Salaam, Tanzania

* *Corresponding author*

Abstract

This paper reports the outcomes of Tanzanian undergraduates and postgraduates' knowledge, attitude, and practice towards Sustainable Development Goals (SDGs). University students from eight universities in Tanzania participated in the study. A set of survey questionnaires based on knowledge, attitude, and practice (KAP) was shared online and 269 responses were obtained to analyse the awareness level (95% confidence level with ±5% margin of error). Data analysis was performed SPSS Statistics version 20. As per descriptive statistics, respondents had a high level of understanding and a positive attitude toward the SDGs. Spearman's rho coefficient correlation was applied to determine the relationships between students' levels on knowledge with practice and attitude with practice. The results revealed no negative correlation between the knowledge and practice towards SDGs ($r = 0.021$, $N = 269$, $p = 0.283$). furthermore, there is no negligible correlation between the attitude and practice towards SDGs ($r = 0.091$, $n = 269$, $p = 0.000$).

Keywords – Attitude, Knowledge, Practice, SDGs, University

Paper type – Academic Research Paper

1 Introduction

In September 2015, the United Nations Summit on Sustainable Development in New York established a worldwide agenda for sustainable development until 2030 and defined a list of objectives on which to focus and achieve by the upcoming fifteen years. These objectives were later established as Sustainable Development Goals (SDGs), providing a shared blueprint for peace and prosperity for the people and the planet of today and future generations. It is also known as the 2030 agenda, with "no one left behind". 193 countries agreed to move toward these goals. They agreed on setting 17 Sustainable Development Goals (SDGs), which is imperative to be adopted by all countries over the world immediately. Within the goals, 230 indicators and 169 targets were set to improve global conditions ("17 Sustainable Development Goals", 2019). The goals are interconnected with each other, as achieving on one will accelerate the growth of tackling common issues within the goals. Here it is identified that eradicating poverty and other deprivations must go together with strategies that improve health and education, reduce inequality, and offshoot economic growth, while simultaneously tackling climate change and preserving oceans and forests ("Sustainable Development Goals", n.d.). The SDGs are a striving step to bring the view of sustainability upon the people in places that have never been achieved before, yet implementation of the changes among the people is a major concern (Fleming et al., 2017). The enactment of the SDGs requires constant participation of all individuals.

1.1 Role of education to sustainable development goals implementation.

The role of education (with SDGs enlightenment as its central focus) is central to achieving the SDGs. just as Health Education is central to Primary Health Care. The United Nations' Educational and Scientific and Cultural Organization (UNESCO) recognizes that education is a major key to sustainable development with its statement "Sustainable development cannot be achieved by technological solutions, political regulation, or financial instruments alone. We need to change the way we think and act. This requires quality education and learning for sustainable development at all levels and in all social contexts.

In order to achieve these goals of global scope, the majority of the population is expected to know about the SDGs, to recognize their importance and to find application for such goals in any professional context, as well as in

personal lifestyle. Nevertheless, the involvement of governments, public and private organizations, as well as academic, scientific, and educational institutions is essential.

This commitment must be translated into global partnerships reflecting the multisectoral cooperation and involvement of society at any level, with a specific mention of a required shared course of action on education, health, and gender equity. Expert groups and academic institutions can assume a pivotal role as catalysts in achieving the SDGs, by promoting fight against inequality, definition of lifestyles, healthy work environments and universal healthcare coverage.

The ultimate result would be an acceleration in the fulfilment of the 2030 Agenda and in the achievement of its goals to promote awareness as well as knowledge and attitudes towards the SDGs in tertiary education. The establishment of partnerships with universities represents a unique opportunity to give birth to a virtuous positive interaction between creation and dissemination of knowledge, hence also assuring the acquisition of required technical skills to develop and maintain a sustainable society interconnected from an economic, healthcare, social and environmental point of view.

The first premise to realize such involvement is represented by adequate competences concerning sustainability themes and the 2030 Agenda's purposes, and, as every individual can have a role in the implementation strategies to realize the SDGs, an intervention from stakeholder professionals of any field is required, as they are able to elevate sustainable development as a national and supranational priority. As affirmed by UNESCO, the role of a proper education, and more specifically of postsecondary education, for the interpretation and implementation of the SDGs is essential to realize 2030 Agenda.

1.2 Background of Tanzania and sustainable development.

The United Republic of Tanzania (Tanzania), which includes the Mainland and Zanzibar, is committed to achieving high-quality, long-term human development for its population. This is engraved in the country's Constitution and in her long-term development visions. There is a strong nation-wide partnership and commitment to implementation, monitoring, tracking, and reporting Sustainable Development Goals (SDGs), backed by a strong political will, collective ownership, integrated planning, and supportive legal frameworks. A "whole-of-society" approach has been adopted, and a robust national SDGs coordination and

monitoring framework, supported by national statistical offices is being developed.

SDGs have been integrated into and are implemented through national medium-term plans, namely, the National Five-Year Development Plan 2016/17 - 2020/21 in the Mainland and the Zanzibar Strategy for Growth and Reduction of Poverty 2016-2020, which also adheres to the three dimensions of sustainable development (economic, social and environment). Tanzania is doing reasonably well in goals 2, 3, 4, 5, 6, 8, 10, 16. Goals 7, 9, 11, 12 are likely to be achieved with stepped-up efforts. Goals 1, 13, 14, 15 17 will need significant local efforts and international support to achieve.

1.3 Why the study focused on university students?

Forming sustainable people and planet is attached to the educational system. Higher education therefore plays a significant role in facing the current agenda by giving education to the agent of change in university then giving birth to the well-educated graduates. Regarding this, the students' awareness and knowledge of 2030 Agenda are said as crucial issues for higher education, this is also what has been a concern for research on sustainability reports disclosed by universities (Ceulemans, Molderez, & Van Liedekerke, 2015).University campuses can be regarded as small towns, and such spaces can be transformed into habitats for the experimental implementation of a new social and technical paradigm that can serve as a focal point in managing sustainability (Ilham et al., 2018b). There are numerous activities that colleges can take to advance the global agenda. The implementation of sustainability at universities can broaden students' potentials and horizons, both on and off campus (Trencher et al., 2014). As a result, it becomes logical to concentrate on students' knowledge, attitudes, and actions toward the SDGs.

2 Literature review

The knowledge, attitude, and practice of university students toward sustainable development was also assessed at the University of Malaya Malaysia (Nusrat Afroz 1 and Zul Ilham,2020) "*The journal of Indonesia sustainable development planning p.31-44"*, where an online and physical questionnaire survey was used to collect data from 382 undergraduate and graduate students. Adopting previous studies conducted by Ahmad and Arifin (2018), Borges (2019), and Omisore

(2019), a knowledge, attitude, and practice (KAP) questionnaire (with a 5-point Likert scale) was designed (2017). The findings revealed a weak negative correlation between knowledge and practice in relation to the SDGs (r = -.264, N = 382, p =.00). There is, however, a strong positive correlation between attitude and practice toward SDGs (r =.440, n = 382, p =. 00). This study suggests that knowledge has less of an impact on achieving SDG goals than attitude, that having more knowledge may not guarantee good practice as attitude might, but it did not address the question of how knowledge might affect attitude. The average positive knowledge of students' cross-tabulated by gender revealed that female students' knowledge (87.89%) was higher than male students' (82.65%). In addition, female students had a higher positive attitude than male students (72.2%) (78.35%). Additionally, female students (56.38%) were more likely than male students (48.31%) to practice SDGs. Furthermore, UM science students had more knowledge of the SDGs (science 85.8%, non-science 81.9%), as well as a more positive attitude toward them (science 78.29%, non-science 68.84%), than non-science students. Instead, UM non-science students had a marginally higher percentage of SDGs practiced than their science counterparts (science 53.3%, non-science 54.6%).

Awareness and Knowledge of the Sustainable Development Goals in a University Community in Southwestern Nigeria (Omisare G., et al., 2017), the purpose of this study was to evaluate how well-versed members in the university community were in the SDGs in terms of awareness, knowledge, and attitudes. 450 students and employees from Osun State University in southwest Nigeria were randomly chosen from three of the university's six campuses to participate in a cross-sectional survey. Using a semi-structured questionnaire, data were gathered. SPSS version 20.0 was used to analyze the data. The respondents' average age was 26(10.2) years. Only 4.2% of respondents had a good understanding of the SDGs, and only 43% were aware of them at all. 56.3%, however, had a favorable attitude toward it. More respondents who had in-depth knowledge of the SDGs were academic staff or people who had learned about them personally or through other means. Additionally, being a member of the academic staff, having a high level of education, and being in the middle of your life were all linked to having a positive attitude. This study includes faculty members and other university personnel, including students. It evaluated the sources from which the staff and students acquired their knowledge of the SDGs, finding that most of them did so through self-learning.

2.1 Sustainable Development Goals

The United Nations' 2030 Agenda for Sustainable Development, also known as the Sustainable Development Goals (SDGs), has been a global agenda for a better future. The degree to which people from various nations are aware of and knowledgeable about the SDGs varies greatly. Since the Millennium Development Goals (MDGs) were completed in 2015, the Sustainable Development Goals project has been underway. Some notable outcomes include a decline in poverty, an increase in primary enrollment and equality, a decrease in child and maternal mortality worldwide, and improved access to sanitation. The Sustainable Development Goals (SDGs), which are the successor agenda, have more substantial elements than the previous one because some achievements have not yet reached the initial goal. The 17 goals and 169 targets that make up the SDGs cover ecological, social, and economic issues. While the MDGs were primarily intended for developing nations in order to advance them, the SDGs would apply to all nations on earth, both developing and developed.

United Nation's blueprint that craves better world by 2030 has set the 17 goals to pursue, (1) no poverty; (2) zero hunger; (3) good health and well-being; (4) quality education; (5) gender equality; (6) clean water and sanitation; (7) affordable and clean energy; (8) decent work and economic growth; (9) industry, innovation and infrastructure; (10) reduced inequalities; (11) sustainable cities and communities; (12) responsible consumption and production; (13) climate action; (14) life below water; (15) life on land; (16) peace, justice and strong institutions; (17) partnership for the goals. Although they are comprised of a complex set of objectives, the sustainable development goals all share the greater technological flexibility and lower cost of actions that will be made possible if policy implementation gets underway sooner. The educational system is linked to creating sustainable individuals and a sustainable planet. Therefore, by educating the change agents in universities and producing well-educated graduates, higher education plays a significant role in addressing the current agenda.

3 Methodology

Non-probability sampling, also known as convenience sampling, was used in this study. Convenience sampling is a type of non-probability sampling in which the sample is drawn from a subset of the population that is easily accessible (Sekaran & Bougie, 2010). The validity of a sample survey is determined by its

ability to extract important information from a small number of respondents in order to depict the characteristics of the entire population (Chuan & Penyelidikan, 2006).

An online and questionnaire survey was used to collect data from 269 undergraduate and graduate students. Adopting previous studies conducted by Ahmad and Arifin (2018), Borges (2019), and Omisore (2019), a knowledge, attitude, and practice (KAP) questionnaire (with a 5-point Likert scale) was designed (2017). The questionnaire was divided into six sections. Section 2 discussed the demographics of the respondents. Sections 3, 4 and 5 assessed respondents' knowledge, attitude, and practice in relation to the Sustainable Development Goals, while Section 6 assessed respondents' opinions such as their sources of knowledge on sustainable development. SPSS Statistics version 20 was used to analyse the data.

3.1 Data Analysis

The level of Students awareness was measured using Chi square test and Descriptive Statistics. The software used for this work is the Statistical Package for the Social Sciences (SPSS) program. Spearman's rho correlation coefficient was used for inferential analysis to determine the correlations between variables (knowledge with practice and attitude with practice). Spearman's coefficient was used because we are measuring ordinal data. The connection was not statistically significant at $p > 0.01$. Negatively composed items were recoded correspondingly. Table 5 provides the result of the r value of Spearman's rho correlation to reflect the strength degree of the association between the variables.

4 Results and Findings

4.1 Respondent's socio-demographic background

According to Table 1, a higher percentage of responses (57.2%) are male, the majority of students (89.2%) are between the ages of 15 and 25, and only one student is between the ages of 18 and 25. 29.7% of respondents attend Muhimbili University of Health and Allied Sciences (MUHAS), 25.7% attend University of Dar-es-Salaam (UDSM), and just 4.8% attend Institute of Finance Management. Most

respondents (91.1%) are seeking a bachelor's degree, while only 7% are pursuing a master's degree. The respondents' knowledge backgrounds were separated into two categories: sciences (69.5%) and non-sciences (30.5%). 112 (42.8%) respondents are in their third year of study while only 6 respondents (2.2%) are in their fifth year of study.

Table 1: Demographics: Variables, Frequency and Percentage (n = 269).

Variables		**Frequency**	**Percentage (%)**
Gender	Male	154	57.2
	Female	115	42.8
Age	15-25	240	89.2
	26-36	26	9.7
	37-47	2	.7
	48-58	1	.4
University	Muhimbili University of health and Allied Sciences (MUHAS)	80	29.7
	University of Dar-es-salaam (UDSM)	69	25.7
	University of Dodoma (UDOM)	47	17.5
	Sokoine university of agriculture	19	7.1
	St Augustine university of Tanzania	11	4.1
	Ardhi University	13	4.8
	Kilimanjaro Christian Medical University College (KCMC)	17	6.3
	Institute of finance management	13	4.8
Education Status			
	Certificate	3	1.1
	Diploma	19	7.1
	Bachelor degree	245	91.1
	Masters	2	.7
Faculty	Science	187	69.5
	Non science	82	30.5
Current study year	First year	42	15.6
	Second year	68	25.3
	Third year	115	42.8
	Fourth year	38	14.1
	Fifth year	6	2.2

4.2 Sustainable development goals knowledge level

The knowledge level of Tanzania students is outstanding (Table 3). Table 3 shows that most students, ranging from 69.5% to 98.1%, answered favorably. With a percentage of 98.1%, item KQ4 "Is the overuse of natural resources affecting the wellbeing of future generations?" received the highest number of positive replies (Yes), indicating that Tanzanian students are knowledgeable about the overuse of natural resources affecting the wellbeing of future generations. The phrase " Are healthy Oceans and seas essential to our existence?" which is part of goal of the SDGs, was answered affirmatively by 97.0% of students. Following that, when asked with statement K1 " Have you ever heard about the term "Sustainable Development Goals (SDGs)" before?" the majority of respondents (88.8%) answered "Yes," but when asked if they knew the goals are projected to be accomplished by 2030, the majority of students (30.5%) didn't know about it.

Table 2 shows the percentages of students who have knowledge of the Sustainable Development Goals.

#	Items	Yes%	No%
KQ1	Have you ever heard about the term "Sustainable Development Goals (SDGs)" before?	88.8	11.2
KQ2	Do you recognize that the word "sustainability" means the ability to be maintained at the certain rate or level?	97.8	2.2
KQ3	Are you aware of the fact that Sustainable Development Goals are targeted to be achieved by the year 2030?	69.5	30.5
KQ4	Is the overuse of natural resources affecting the wellbeing of future generations?	98.1	1.9
KQ5	Is it a must for all people in the world to achieve access to good education in order to achieve sustainable development?	79.6	20.4
KQ6	Are Environmental protection, economic growth and social equity the fundamental elements of a nation?	95.5	4.5
KQ7	Are healthy Oceans and seas essential to our existence?	97.0	3.0
KQ8	Can the increased use of renewable resources reduce greenhouse gas emissions?	91.4	8.6
KQ9	Is income inequality a global problem that requires global solutions?	83.6	16.4
KQ10	Is maintaining good relationships with various countries crucial to preserve peace around the world?	97.8	2.2

4.3 Sustainable development goals attitude level

Table 3 below depicts the attitude of Tanzanian students towards the Sustainable Development Goals. We can see that all the statements are affirmative and majority of the respondents responded "Agree" and "Strongly Agree". Table 3 highlights favorable attitudes with a grey background. Statement AQ3, "To me, raising awareness on Sustainable Development Goals among the university students is necessary," received the largest number of "Strongly Agree" responses from students (61.0%). This demonstrates that Tanzanian students understand the need to raise awareness on Sustainable Development Goals among the university students. The majority of respondents (45.4%) agreed they conserve the use of electric energy at their place. When asked if males and females should be treated equally in all aspects of life, 29.7% agreed, 8.6% disagreed and 14.1% responded Neutral. Nonetheless, respondents overwhelmingly supported the Sustainable Development Goals.

Table 3. Shows the percentage of students attitudes towards the Sustainable Development Goals.

#	Items	SD*(%)	D*(%)	N*(%)	A%	SA%
AQ1	Reducing poverty and hunger in the world are more important than increasing the economic welfare of the industrialized countries	6.3	4.1	16.4	36.1	37.2
AQ2	To me, society should be provided with the best free basic health services.	4.5	2.6	5.6	32.0	55.4
AQ3	To me, raising awareness on Sustainable Development Goals among the university students is necessary.	3.3	0.7	4.1	30.9	61.0
AQ4	I feel basic environmental courses should be a part of our university curriculum.	3.7	2.2	13.0	39.4	41.6
AQ5	I think in society, males and females should be treated equally in all aspects of life.	7.1	8.6	14.1	29.7	40.5
AQ6	The rise of global temperature has increased water scarcity.	3.7	3.3	6.3	39.0	47.6
AQ7	Environmental problems are a matter of my concern.	4.5	2.2	10.0	38.3	45.0
AQ8	People from varying cultural backgrounds must be treated with the same respect.	3.7	4.8	11.2	24.2	56.1
AQ9	I try to conserve the use of electric energy at my place.	3.0	5.2	21.6	45.4	24.9
AQ10	I try to reduce the amount of waste at home by collecting materials that can be	2.2	6.7	20.4	42.0	28.6

	recycled.					
AQ11	Functioning and resilient infrastructure is the foundation of every successful community.	2.2	1.9	13.8	45.0	37.2
AQ12	The government should take greater account of sustainability within their political decision.	2.2	1.1	5.2	39.8	51.7
AQ13	Research and educational institutions should take greater account of sustainability in their activities and campaigns.	2.2	0.4	5.6	43.1	48.7
AQ14	I believe that participation in a sustainable lifestyle will bring peace and justice globally.	2.2	0.7	10.0	41.3	45.7
AQ15	I am willing to utilize renewable energy.	2.2	0.4	6.7	36.1	54.6

(***SD***=Strongly disagree, ***D***=Disagree, ***N***=Neutral, ***A***=Agree, ***SA***=Strongly agree)

4.4 Sustainable development goals practice level

Table 4 below depicts the practice of Tanzanian students towards the Sustainable Development Goals. Majority of the students responded "Often" and "Agreed". From the statements, it can be seen that majority of the students often (41.3%) avoid the use of plastic straws at restaurants/cafes, 45.7% agreed that they use their own reusable bag for grocery shopping. 77.3% agreed that they switch off appliances of their homes whenever they are not around. On a scale of 1 to 5, 45.7% are very interested in the environmentally friendly products and also majority of the respondents (39.4%) have slightly few courses related to environmental sustainability that they took.

Table 4. Shows the percentage of student practice towards the Sustainable Development Goals.

#	Items	N*(%)	R*(%)	S* (%)	O*(%)	A*(%)
PQ1	I avoid using plastic straws at restaurants/cafes.	8.6	14.9	13.0	41.3	22.3
PQ2	I bring my own reusable bag for grocery shopping.	8.2	5.2	17.5	23.4	45.7
PQ3	I discard recyclable material (ex: plastic bottles, newspaper, glass) separately at home.	11.5	11.9	16.7	27.9	32.0
PQ4	I conserve the use	1.9	2.6	14.9	16.7	63.9

	of water supply at my place.					
PQ5	I treat people from all caste, creed and religion equally.	1.1	3.3	8.2	14.5	72.9
PQ6	I prefer public transport rather than a private one.	11.9	8.2	15.2	32.0	32.7
PQ7	I switch off electrical appliances of my home that I don't need when I am not around.	1.5	2.2	7.8	11.2	77.3
PQ8	I turn off the air-conditioner and lights of the classroom after the class finishes and gets is empty at my university.	14.9	13.0	7.4	23.4	41.3
PQ9	I avoid using the animal skinned [animal skin] product	18.2	13.0	14.1	30.9	23.8
PQ10	I participate in events (ex: [as] seminar, talk, workshop) that relates to sustainability.	10.8	13.4	9.3	42.8	23.8
PQ11	I talk about environmental sustainability with your friends and family.	9.3	11.2	13.4	40.5	25.3
#	**Items**	**NI*(%)**	**RI*(%)**	**SI*(%)**	**OI*(%)**	**VI*(%)**
PQ12	On a scale of 1 to 5 please the rate the level of interest to pay more on environmentally friendly products	7.1	4.8	19.7	22.7	45.7
#	**Items**	**SFC*(%)**	**FC*(%)**	**MAC*(%)**	**MOC*(%)**	**SMC*(%)**
PQ13	On a scale of 1 to 5 please rate the number of courses related to environmental	39.4	8.9	23.0	11.5	17.1

	sustainability that you took.					

(***N***= Never, ***R***= Rarely, ***S***= Sometimes, ***O***=Often, ***A***=Always), (***NI***= Not interested, ***RI***= Rarely interested, ***SI***= Sometimes interested, ***OI***= Often interested, ***VI***=Very interested), (***SFC***= Slightly few courses, ***FC***= Few courses, ***MAC***= Many courses, ***MOC***= More course, ***SMC***= Slightly more courses).

From Table 5 below, it depicts there is no negligible relationship between student knowledge and SDG practice level (r= 0.021, N = 269, p =0.283). Table 7, indicating that while Tanzanian students might have strong Knowledge of SDGs, their practice level is extremely poor. Students may need to understand how to practice SDG rather than simply having only knowledge about them. Also, there is no negligible relationship between student attitude and SDG practice level (r= 0.091, N = 269, p =0.000), indicating that rather than having good attitude, without practice level, will result in no correlation.

Table 5. Shows the correlation between student Knowledge and practice, Attitude and practice towards the Sustainable Development Goals.

Correlations						
			Knowledge	Attitude	Practice	Inference
Spearman's rho	Knowledge	Correlation Coefficient	1.000	.014	.021	No correlation
		Sig. (2-tailed)	.	.475	.283	
		N	269	269	269	
	Attitude	Correlation Coefficient	.014	1.000	.091**	No correlation
		Sig. (2-tailed)	.475	.	.000	
		N	269	269	269	
	Practice	Correlation Coefficient	.021	.091**	1.000	No correlation
		Sig. (2-tailed)	.283	.000	.	
		N	269	269	269	
**. Correlation is significant at the 0.01 level (2-tailed).						

A detailed cross-tabulation was performed to access knowledge, attitude, and practice level in connection to gender. A cross-tabulation of students' average positive knowledge based on gender and it revealed that 138 male students' knowledge was higher than 101 female students. Similarly, 61 male students had a higher positive attitude than 39 female students. 41 male students were also more likely to practice SDGs than 19 female students.

5 Conclusion

In summary, the general level of awareness of SDGs among Tanzanian students is strong, as shown by the percentage of students who have good knowledge and a favorable attitude. Nonetheless, they performed below average in terms of SDG implementation because they have no correlation. There is a no relationship between student knowledge and practice level, indicating that while Tanzanian students have high understanding of the SDGs, their practice level is slightly lower, however this can be increased through the university's strategic initiatives and intervention programs. There is, also, no positive relationship between student attitude and practice level. Further research can be conducted to investigate the methods and approaches which can be employed to provide Sustainable development goals (SDG) education awareness, and additionally to stimulate positive attitudes and improve practice levels at various levels of education, particularly at the highest level, which is universities and colleges.

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Effects of Virtual Influencer Marketing on Purchase Intention: Perceived Characterizations as Mediators

Yini Lin*

International Business, National Taipei University of Business
No.321, Sec. 1, Jinan Rd., Zhongzheng District, Taipei City 100,
Taiwan (R.O.C.)

Tzu-Hsuan Kuo

International Business, National Taipei University of Business
No. 321, Sec. 1, Jinan Rd., Zhongzheng District, Taipei City 100,
Taiwan (R.O.C.)

* *Corresponding author*

Abstract

In recent years, the discussion around virtual influencers has been growing. These virtual personalities have a huge following among young people, with an engagement rate three times higher than that of YouTubers. This has made people realize the business opportunities in this industry. To explore how influencer attributes and perceived characterizations affect consumers' purchase intention, this study uses the S-O-R theoretical framework proposed by Mehrabian and Russell in 1974. The study focuses on three influencer attributes: attitude homophily, physical attractiveness, and social attractiveness, and three perceived characterizations: trustworthiness, parasocial interaction, and brand equity. Perceived characterizations are regarded as a mediator in this study. The research sample consists of 479 people who were sampled from VTubers research groups on social media. The study uses structural equation modeling (SEM) to test the proposed model. The results show that influencer attributes have a significant and positive effect on perceived characterizations. Perceived characterizations, in turn, have a significant and positive effect on consumers' purchase intention. Additionally, perceived characterizations have a significant mediation effect. This research provides valuable insights for VTubers marketers. By understanding the influence of attributes and characterizations, marketers can develop more effective strategies for promoting their products and services through virtual influencers. In conclusion, virtual influencers have a significant impact on consumers' purchase intention, and this study provides important insights into how influencer attributes and perceived characterizations affect consumer behavior. By understanding these factors, VTubers marketers can improve their marketing strategies and better leverage the power of virtual influencers. Text of the abstract

Keywords – VTuber, Influencer Attributes, Perceived Characterizations, Purchase Intention

1 Introduction

The global virtual influencer industry is rapidly growing due to technological developments, including AI, AR, and VR, and the widespread popularity of the internet and social media. According to HypeAuditor (2021), virtual influencers have engagement rates three times higher than human influencers, with a significant following among females aged 18 to 34, including a significant proportion of Generation Z aged 13 to 17. The unique aspect of virtual influencers is their ability to express their thoughts and ideas, representing disadvantaged groups and creating a human-like connection with their audience. This makes them an attractive option for businesses, as they maintain a positive image and can appear anywhere, anytime.

This study focuses on the commercial operation of VTubers, a type of virtual influencer that has seen exponential growth in recent years. Previous research by Horan (2015), Purnamaningsih and Rizkalla (2020), Masuda, Han and Lee (2022), Chang et al. (2019), and Kurtin et al. (2018) indicates that influencer attributes such as attitude homophily, physical attractiveness, and social attractiveness positively affect parasocial interaction and trustworthiness. This positive image can effectively improve brand image, and social media engagement rates of celebrities, representing social attractiveness, have a significant impact on trustworthiness.

Additionally, Misra and Baetty (1990) found that the connection between spokesmen and brands creates enhanced emotional connections between consumers and brands, thus improving brand equity. Chen and Wu (2017) and Dean (1999) both found that the attractiveness and reputation of spokesmen can effectively enhance brand image and impact society. This study takes attitude homophily, physical attractiveness, and social attractiveness into account as factors affecting trustworthiness, parasocial interaction, and brand equity.

Trustworthiness significantly influences purchase intention, as found by Leung, Sun, and Asswailem (2022) and Bhatti (2017). Hsu, Yu, and Chen (2022) also found that higher perceived trustworthiness of influencers leads to stronger stimulation of purchase intention. Positive brand image and recognition also lead to stronger purchase intention, as found by Huang (2020) and Romaniuk and Sharp (2003). Brand equity positively affects purchase intention, as shown by Rizwan, Al-Malkawi, Gadar, Sentosa, and Abdullah (2021). Additionally, parasocial interaction also influences purchase intention, according to Purnamaningsih and Rizkalla

(2020) and Lin, Pierre, Crowe, and Lee (2021). Shen, Zhao, Fan, and Buhalis (2022) found that audience emotions during live streaming can adjust the impact of parasocial interaction, influencing their purchase intention.

Based on the above research background and motivations, this study aims to explore the relationship between virtual influencer attributes, perceived characterizations, and purchase intention. Specifically, the study aims to discuss the effect of virtual influencer attributes on perceived characterizations, the effect of perceived characterizations on purchase intention, and the mediating effect of perceived characterizations.

2 Literature Review

2.1 Overview of Virtual Influencer Industry

The virtual influencer industry originated in Japan, referring to a character that combines a virtual image with a real person using motion capture technology. The industry is divided into two categories: independently produced and corporately produced. Hololive Production, a company with 22 VTubers, is one of the most popular and profitable virtual influencer companies. It has entered various overseas markets and reportedly made a yearly profit of over 1 billion yen (ET Net, 2021). The virtual influencer industry is growing rapidly, with over 16,000 VTubers as of October 2021 (UserLocal, 2021). Brands are taking notice of virtual influencers, and more and more are collaborating with them.

2.2 Influencer Attributes

2.2.1 Attitude Homophily

Attitude homophily refers to the similarity of thoughts, values, and attitudes. It is a crucial factor in establishing relationships among individuals. Research has shown that similarity in attitudes and character is more relevant to explain the differences in homophily than traditional demographics (Byrne, Griffitt, and Stefaniak, 1967; Byrne and Nelson, 1965; Byrne and Rhamey, 1965). In addition, individuals tend to connect with each other based on personal perceived recognition and mental characteristics, as well as shared common interests with groups (Blanton, 2001; Palmer, Brewer, Weber, and Nagesh, 2013). Having similar

friends on social media can lead to more supportive interaction and increased satisfaction (Oh, Ozkaya, and LaRose, 2014).

2.2.2 Attractiveness

Attractiveness plays an essential role in establishing relationships among individuals. Physical attractiveness refers to the satisfaction level of one's physical features aesthetically. Socioculturally relevant attributes, particular preferences, and facial symmetry are factors that impact attractiveness. People tend to attribute positive features like wisdom, ability, and enthusiasm to individuals with beautiful faces (Agthe, Spörrle, Frey, Walper, and Maner, 2013). In addition, consumers have a positive impression of attractive celebrities and transfer this attitude to the products they endorse (Debevec and Kernan, 1984). Social attractiveness includes proximity, intimacy, similarity, and complementarity. Proximity, the main reason for interpersonal attraction, refers to the physical or mental closeness between people. Intimate relationships involve physical or emotional relationships characterized by lasting dependence, frequent interaction, emotional connection, and mental satisfaction. People are attracted to those with similar characteristics, goals, and appearance. Those with low self-esteem are more willing to establish complementary relationships (Heine, Foster, and Spina, 2009).

2.3 Perceived Characterizations

2.3.1 Trustworthiness

Trustworthiness refers to the quality of how an individual persuades and how much others believe in them (Singletary, 1976). It consists of reliability and professionalism, which refers to the seller's ability to convey goods or services and fulfill its promise of goods, respectively (Erdem and Swait, 2004). Chen and Wu (2017), Bhatt, Jayswal, and Patel (2013), and Ohanian (1990) divided trustworthiness into three categories: professionalism, reliability, and attractiveness, respectively. Professionalism refers to influencers' professional knowledge of certain products, while reliability encompasses honesty, fairness, and worth-trusting characteristics. Attractiveness refers to influencers' individual attraction. Trustworthiness can impact consumer product comments, the persuasion of products or services, and reflects whether information receivers agree with information spreaders or not.

2.3.2 Parasocial Interaction

The initial concept of Parasocial Interaction was referred to Horton and Wohl (1956), it is also called Parasocial Interaction (PSI), they described this interaction as "Simulacrum of conversational give and take" between audience and performer. In the past, Parasocial Interaction was one-way, but now, it is instant two-way between audience and media. In the words of Zheng, Yu & Wu (2019), Parasocial interaction started from the rise of mass media. Over time, the ways of marketing have been from flyers to television, to social media now, the way of parasocial interaction has changed accordingly. Traditional theory had more focused on the relationship between audience and announcers (Auter, 1992; Rubin and Step, 2000). On the other hand, due to the Internet, the research of parasocial interaction has expanded into consumers. Nowadays, social platforms like YouTube can market or embed advertising or products, in addition to sharing life videos. In addition, online influencers have played an important role in consumers' life (Zheng et al., 2019). As previously mentioned, this study wants to investigate whether virtual influencers can establish a relationship with consumers and thus have more business opportunities.

2.3.3 Brand Equity

According to Shocker and Weitz (1988), Brand equity consists of impression and loyalty. Aaker (1991) divided Brand Equity into (1) Brand Loyalty: brand preference of consumers, the core of Brand Equity; (2) Brand Awareness: how much consumers remember a brand; (3) Perceived Quality: the whole brand image and quality for consumers; (4) Brand Association: the association generated by consumers through a brand; (5) Proprietary Assets: such as, patent, trademark, and so on. Brand Equity is created from the different reactions of consumers which will express through behavior, recognition, and preference. It can also be said that Brand Equity includes Brand Awareness and Brand Meaning (Berry, 2002). Also, the overall quality of products and purchase intention are used to delegate to Brand Equity (Agarwal and Rao, 1996). The status of the brand, consumers' attitude toward the brand, and the profit the brand will make also belong to Brand Equity (Keller, 2003).

2.4 Purchase Intention

Dodds, Monroe, and Grewal (1991) defined Purchase intention as the possibility of what consumers are willing to purchase. Spears and Singh (2004) showed that Purchase Intention is that consumers buy something consciously, is created by just having a good impression of merchandise. At the same time, Fishbein and Ajzen (1975) indicated that Purchase Intention consists of the consumers' attitude or comments for brands or products and external factors. Kotler (2016) further defined Purchase Intention as the priority order of purchasing. Purchase intention is often used to estimate consumers' consumption behavior (Jung, Choi and Oh, 2020). Cheng et al. (2021) also proved that Purchase Intention is used as the standard for measuring purchasing behavior. Thus, this study is going to incorporate consumers' purchase intention into the measurement basis for the effectiveness of virtual influencer endorsements. Taking virtual influencer endorsements as a mediator for shaping brand attitudes, after the brand attitude is formed, coupled with the external environment's acceptance of virtual influencers, it determines whether consumers will choose the brand endorsed by virtual influencers from among many brands, which is the formation of purchase intentions.

3 Methodology

3.1 Research Framework

This study adopts the S-O-R model (Stimuli-Organism-Response) proposed by Mehrabian and Russell (1974) to investigate the impact of virtual influencers on brand purchase intention. Stimuli, the first stage, is created by consumer motivation towards virtual influencers and external environment. Attitude homophily, physical attractiveness, and social attractiveness are identified as influencers. In the second stage, organism, consumers' organic perception is shaped after receiving motivation. Perceived characterizations (trustworthiness, parasocial interaction, and brand equity) are shown to be associated with purchase intention. Finally, behavior intention is measured by purchase intention. This study utilizes the three perceived characterizations as mediators for purchase intention. Figure 3-1 illustrates the research framework. In order to explore how the assessment and management of knowledge assets can support NPD process

performance improvements, I have carried out an empirical research based on multiple case studies (Eisenhardt, 1989; Mintzberg, 1979; Mintzberg and Waters, 1982; Yin, 1984).

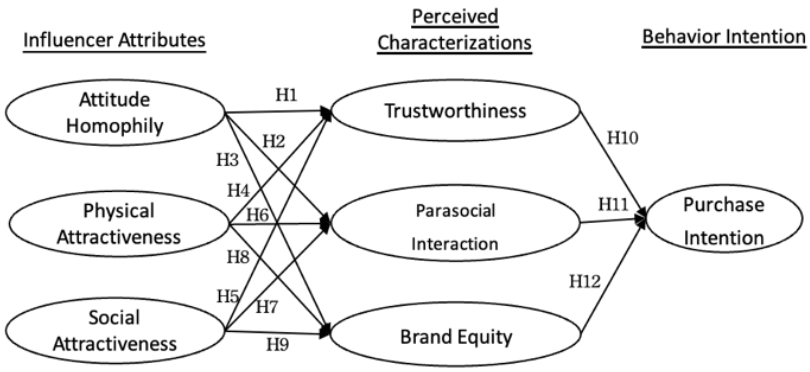

Figure 3-1 Research Framework

3.2 Research Hypotheses

3.2.1 The relationship between Attitude Homophily and Perceived Characterizations

Attitude Homophily has a pre-conditioned positive impact on Trustworthiness (Li and Du, 2011; Djafarova and Rushworth, 2017) and Parasocial Interaction (Sokolova and Kefi, 2020). The similarity between consumers and virtual influencers increases consumers' purchase intention (Hook, Baxter, and Kulczynski, 2020; Ki and Kim, 2019; Lee and Watkins, 2016; Schouten et al., 2020), and positively affects brand equity (Schouten et al., 2020). Based on these findings, this study proposes the following hypotheses:

H1: Attitude Homophily has a positive impact on Trustworthiness.

H2: Attitude Homophily has a positive impact on Parasocial Interaction.

H3: Attitude Homophily has a positive impact on Brand Equity.

3.2.2 The relationship between Attractiveness and Perceived Characterizations

Physical Attractiveness has a pre-conditioned positive impact on Trustworthiness (Ert and Fleischer, 2020; Sokolova and Kefi, 2020), and Social Attractiveness positively affects Social Attractiveness (Masuda et al., 2022). Physical Attractiveness and Social Attractiveness have a positive impact on Parasocial Interaction (Lee and Watkins, 2016; Lou and Kim, 2019; Masuda et al.,

2022), and Brand Equity (Dwivedi et al., 2015; Lieven, 2016; Menon et al., 2001). Thus, this study proposes the following hypotheses:

H4: Physical Attractiveness has a positive impact on Trustworthiness.

H5: Social Attractiveness has a positive impact on Trustworthiness.

H6: Physical Attractiveness has a positive impact on Parasocial Interaction.

H7: Social Attractiveness has a positive impact on Parasocial Interaction.

H8: Physical Attractiveness has a positive impact on Brand Equity.

H9: Social Attractiveness has a positive impact on Brand Equity.

3.2.3 The relationship between Trustworthiness and Purchase Intention

Trustworthiness is a significant determinant of followers' purchase intentions (Djafarova and Rushworth, 2017; Erkan and Evans, 2016; Reichelt et al., 2014; Schouten et al., 2020; Sokolova and Kefi, 2020). Thus, this study proposes the following hypothesis:

H10: Trustworthiness has a positive impact on Purchase Intention.

3.2.4 The relationship between Parasocial Interaction and Purchase Intention

Parasocial Interaction is positively related to purchase intention (Hwang and Zhang, 2018; Masuda et al., 2022; Shen et al., 2022). Thus, this study proposes the following hypothesis:

H11: Parasocial Interaction has a positive impact on Purchase Intention.

3.2.5 The relationship between Brand Equity and Purchase Intention

Brand Equity has a positive impact on purchase intention (Aaker, 1991; Keller, 1993; Tharmi and Senthilnathan, 2011). Thus, this study proposes the following hypothesis:

H12: Brand Equity has a positive impact on Purchase Intention.

3.3 The sample design and data collection

The research methodology employed in this study is a questionnaire survey, with the target respondents being individuals who watch or follow virtual influencers. The survey was conducted from November 1, 2021, to January 26, 2022, spanning a period of three months. A total of 504 responses were collected, out of which 479 were deemed valid, resulting in an effective questionnaire rate of 95%.

3.4 Measure development

The measure constructs in this study include Influencer Attributes (Attitude Homophily, Physical Attractiveness, and Social Attractiveness), Perceived Characterizations (Trustworthiness, Parasocial Interaction, and Brand Equity), and Behavior Intention (Purchase Intention). The samples were measured using a Likert 5-Point Scale, with 1 being "totally disagree" and 5 being "totally agree." To measure Attitude Homophily, this study refers to the views of Lou and Kim (2019) and developed three questions based on McPherson et al (2001), Rogers and Bhowmik (1970), and McCormick (2016). To define Physical and Social Attractiveness, this study refers to the viewpoints of Duran and Kelly (1988) and Lee (2010), respectively, and developed seven questions based on Berscheid and Walster (1974), Lee and Watkins (2016), Joseph (1982), Sokolova and Kefi (2020), Batra et al. (2012), and Carroll and Ahuvia (2006). To define Trustworthiness, this study refers to the views of Lou and Kim (2019) and developed three questions based on Reichelt, Sievert and Jacob (2014), Erkan and Evans (2016), and Sokolova and Kefi (2020). To define Parasocial Interaction, this study refers to the views of Rubin and Perse (1987) and developed four questions based on Horton and Wohl (1956), Masuda et al. (2022), and Hwang and Zhang (2018). To define Brand Equity, this study refers to the views of Aaker (1991) and developed five questions based on Keller (1993) and Lofgren and Li (2010). Finally, to define Purchase Intention, this study refers to the viewpoint of Lofgren and Li (2010) and developed three questions based on Zeng (2008).

4 Analysis Results

4.1 Descriptive Statistics Analysis

According to We Are Social's (2021) research on online social communities in Taiwan in 2020, the most popular social media platforms in Taiwan are YouTube (89.6%), Facebook (89.2%), Line (88.0%), and Instagram (59.5%). In addition, OpView's (2022) data from the third media annual report in 2021 revealed that Dcard had the most significant online reputation growth compared to other social platforms, with an increase of 34.4% since 2020. Thus, the study selected Facebook, Line, Instagram, and Dcard, as well as virtual influencer communities on these four platforms, to achieve a higher effective questionnaire rate. A total of

504 samples were collected and tested for participation bias, with 479 being deemed effective, resulting in an effective questionnaire rate of 95% (479/504).

The effective samples were analyzed through Descriptive Statistic Analysis, with male respondents accounting for 70.1%, consistent with the trend observed by STRATE, which found that more males watched VTubers than females in 2021. Furthermore, the majority of respondents were 18 years old (48.0%), followed by 19-25 years old (36.7%), and were mainly students. According to iiMedia Research, at least 70% of the audience falls within the age range of 18 to 23, which also comprises Generation Z. As a result, the majority of the respondents being students (73.1%) and having a disposable income below NTD$5,000 (53.0%), followed by NTD$5,001 - $15,000 (25.1%), is not surprising. The collected samples are thus representative of the current trend.

4.2 Structural Equation Modeling Analysis

This study utilized Structural Equation Modeling with Amos 26.0. The analysis was conducted using the two-phase method proposed by Anderson and Gerbing (1988). In the first phase, the measurement model was assessed for its validity and reliability. In the second phase, the structural model was tested to determine the significance of the hypotheses.

4.2.1 Measurement Model

Table 4-1 shows the results of the Confirmatory Factor Analysis for the measurement model. The model fit indices indicate that the model has a good fit. The ratio of $\chi 2/df$ is 2.503, which falls within the recommended range of 1 to 3 (Hair et al., 1998). The Goodness-of-Fit Index (GFI) is 0.907, which is greater than the recommended value of 0.9 (Bentler, 1983). The Adjusted Goodness-of-Fit Index (AGFI) is 0.874, which exceeds the recommended value of 0.8 (Bentler and Hu, 1999). The Comparative Fit Index (CFI) is 0.936, which also exceeds the recommended value of 0.9 (Byrne, 1994; Bentler, 1995). Lastly, the Root Mean Square Error of Approximation (RMSEA) is 0.056, which is below the recommended standard of 0.06 (Hu and Bentler, 1999). These results indicate that the measurement model is a good fit.

The results for the Factor Loading (FL) indicate that all observable variables have sufficient validity to reflect their corresponding latent variable, with FL values exceeding 0.45 (Bentler and Wu, 1993). The Cronbach's α values for all constructs

are greater than 0.6 (Nunnally, 1978), indicating good reliability. The Composite Reliability (CR) and Average Variance Extracted (AVE) values also meet the recommended standards of 0.6 (Hair et al., 2006) and 0.36 (Fornell and Larcker, 1981), respectively, indicating good convergent validity.

In terms of Discriminant Validity, the square root of AVE value for each construct exceeds its corresponding variance with any other construct (Fornell and Larcker, 1981), as shown in Table 4-2, indicating good discriminant validity. Additionally, all correlation coefficients have a significant impact, making the research suitable for structural model analysis.

4.2.2 Structural Model

The results of the structural model analysis are presented in Table 4-3. The study obtained good model fit, as evidenced by the values of $\chi 2/df$, GFI, AGFI, CFI, and RMSEA, which meet the established standards (Hair et al., 1998; Bentler, 1983; Bentler, 1995; Browne and Cudeck, 1993). Therefore, the structural model is considered a good fit for the data (Baumgartner and Homburg, 1996).

The standardized path coefficients in Table 4-3 demonstrate that three of the Attitude Homophily (ATH) hypotheses have significant impacts: ATH to Trustworthiness (TW) ($\beta = 0.289$, $p < 0.001$), ATH to Parasocial Interaction (PR) ($\beta = 0.267$, $p < 0.001$), and ATH to Brand Equity (BE) ($\beta = 0.165$, $p < 0.001$). Therefore, hypotheses H1, H2, and H3 are supported. The Physical Attractiveness (PA) hypotheses also have significant impacts on TW ($\beta = 0.191$, $p < 0.001$) and PR ($\beta = 0.230$, $p < 0.001$); thus, H4 and H6 are supported, while the PA hypothesis for BE ($\beta = 0.050$, $p > 0.05$) is not supported (H8).

The Social Attractiveness (SA) hypotheses all have significant impacts on TW ($\beta = 0.300$, $p < 0.001$), PR ($\beta = 0.349$, $p < 0.001$), and BE ($\beta = 0.571$, $p < 0.001$); therefore, H5, H7, and H9 are supported. Finally, the TW to Parasocial Interaction (PI) ($\beta = 0.139$, $p < 0.001$), PR to PI ($\beta = 0.101$, $p < 0.001$), and BE to PI ($\beta = 0.502$, $p < 0.01$) hypotheses all have significant impacts, thus, H10, H11, and H12 are supported. In conclusion, all hypotheses except H8 are supported by the analysis

4.3 Mediating effect

Based on the results of the structural model, it has been proven that TW, PR, and BE significantly impact PI. Thus, this study aims to further investigate the mediating effect between Influencer Attributes and Perceived Characterizations.

To test this, the study uses the Bootstrapping Method recommended by Preacher and Hayes (2008). According to Zhao et al. (2012), this method is better for testing mediating effects as it takes the research sample as the population and calculates the confidence interval (CI) through 2,000 estimations. If the indirect effect CI does not contain 0, it means that the indirect effect is significant; otherwise, it is not significant.

The results in Table 4-4 show that all mediating effects are significant except for SA-TW-PI and SA-PR-PI under the 95% percentile CI and bias CI. Thus, we can confirm that the indirect effect exists, which means TW respectively plays a mediator between ATH, PA and PI; PR also respectively plays a mediator between ATH, PA and PI, and BE respectively plays a mediator between ATH, SA and PI.

According to the testing process of mediating effects proposed by Baron and Kenny (1986) as shown in Table 4-5, it is noted that the direct effects of ATH-TW-PI, ATH-PR-PI, ATH-BE-PI, and PA-TW-PI are not significant (βATH-PI= 0.023, 0.070, -0.077, βPA-PI= 0.084), which proves that TW, PR, and BE have complete mediating effects between ATH and PI, and TW has a complete mediating effect between PA and PI. Additionally, taking IV and M to test the impact on DV at the same time in the paths of PA-PR-PI and SA-BE-PI, both IV and M have a significant impact on DV. Thus, it proves that PR has a partial mediating effect between PA and PI, and BE has a partial mediating effect between SA and PI.

Table 4-1. Convergent Validity

Constructs	FL	CR	AVE
ATH	0.56~0.83	0.77	0.53
PA	0.61~0.80	0.78	0.54
SA	0.51~0.79	0.73	0.41
TW	0.48~0.76	0.65	0.39
PR	0.58~0.75	0.76	0.45
BE	0.53~0.82	0.84	0.51
PI	0.60~0.90	0.85	0.65
Fit Statistics: χ^2/df = 2.503, GFI = 0.907, AGFI = 0.874, CFI = 0.936, RMSEA = 0.056			

Note: 1. ATH= Attitude Homophily; PA= Physical Attractiveness;
SA= Social Attractiveness; TW= Trustworthiness;
PR= Parasocial Interaction; BE= Brand Equity;
PI= Purchase Intention.

Table 4-2. Discriminant Validity

Constructs	Correlation Coefficients						
	ATH	PA	SA	TW	PR	BE	PI
ATH	0.890						
PA	0.433**	0.884					
SA	0.526**	0.549**	0.569				
TW	0.548**	0.467**	0.318**	0.592			
PR	0.558**	0.527**	0.332**	0.566**	0.619		
BE	0.484**	0.408**	0.526**	0.453**	0.538**	0.707	
PI	0.248**	0.264**	0.519**	0.424**	0.358**	0.634**	0.713

Note: 1. ATH= Attitude Homophily; PA= Physical Attractiveness;
SA= Social Attractiveness; TW= Trustworthiness;
PR= Parasocial Interaction; BE= Brand Equity;
PI= Purchase Intention.
2. Lower triangle is the Pearson correlation coefficient.
3. * p < 0.05; ** p < 0.01

Table 4-3. Path Coefficients

Hypothesis	Research Hypothesis	Path Coefficients (β)
H1	ATH → TW	0.289***
H2	ATH → PR	0.267***
H3	ATH → BE	0.165***
H4	PA → TW	0.191***
H5	SA → TW	0.300***
H6	PA → PR	0.230***
H7	SA → PR	0.349***
H8	PA → BE	0.050
H9	SA → BE	0.571***
H10	TW → PI	0.139***
H11	PR → PI	0.101**
H12	BE → PI	0.502***
Fit Index: χ^2/df = 1.630, GFI = 0.943, AGFI = 0.917, CFI = 0.975, RMSEA = 0.036		

Note: 1. ATH= Attitude Homophily; PA= Physical Attractiveness;
SA= Social Attractiveness; TW= Trustworthiness;
PR= Parasocial Interaction; BE= Brand Equity;
PI= Purchase Intention.
** p < 0.01; *** p < 0.001

Table 4-4. Bootstrapping Method

IV	M	DV	Bootstrapping 95% CI (CI)	
			Percentile CI	Bias CI
ATH	TW	PI	0.428~0.928	0.431~0.942
ATH	PR	PI	0.222~0.446	0.229~0.458
ATH	BE	PI	0.354~0.603	0.356~0.605
PA	TW	PI	0.373~0.633	0.378~0.643
PA	PR	PI	0.239~0.465	0.246~0.477

SA	TW	PI	-0.017~0.387	-0.033~0.376
SA	PR	PI	-0.360~0.066	-0.357~0.066
SA	BE	PI	0.392~1.127	0.386~1.117

Note: 1. ATH= Attitude Homophily; PA= Physical Attractiveness; SA= Social Attractiveness; TW= Trustworthiness; PR= Parasocial Interaction;
BE= Brand Equity; PI= Purchase Intention.
2. IV=Independent Variable, M=Mediating Variable, DV=Dependent Variable

Table 4-5. Stepwise Regression

IV	M	DV	IV→DV		IV→M		IV+M→DV			
							IV→DV		M→DV	
			β	S.E.	β	S.E.	β	S.E.	β	S.E.
ATH	TW	PI	0.248***	0.045	0.548***	0.036	0.023	0.050	0.412***	0.053
ATH	PR	PI	0.248***	0.045	0.558***	0.029	0.070	0.052	0.319***	0.068
ATH	BE	PI	0.248***	0.045	0.484***	0.042	0.077	0.041	0.671***	0.038
PA	TW	PI	0.264***	0.061	0.467***	0.053	0.084	0.065	0.385***	0.050
PA	PR	PI	0.264***	0.061	0.527***	0.041	0.104*	0.069	0.303***	0.066
SA	BE	PI	0.519***	0.043	0.684***	0.038	0.161**	0.052	0.524***	0.046

Note: 1. ATH= Attitude Homophily; PA= Physical Attractiveness; SA= Social Attractiveness; TW= Trustworthiness; PR= Parasocial Interaction;
BE= Brand Equity; PI= Purchase Intention.
2. IV=Independent Variable, M=Mediating Variable, DV=Dependent Variable
3. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

5 Conclusions

In this study, the S-O-R Model proposed by Mehrabian and Russell (1974) was used to examine the relationship between Influencer Attribute and consumers' Behavior Intention. The findings revealed significant relationships between Influencer Attribute (Attitude Homophily, Physical Attractiveness, Social Attractiveness) and Perceived Characterizations (Trustworthiness, Parasocial Interaction, Brand Equity). Furthermore, Perceived Characterizations were found to be significant mediators between Influencer Attribute and Behavior Intention (Purchase Intention).

5.1 The Impact of Influencer Attribute on Perceived Characterizations

The results of this study suggest that Attitude Homophily has a positive impact on consumers' Perceived Characterizations. This finding is consistent with previous research results (e.g., Li and Du, 2011; Al-Emadi and Yahia, 2020), which suggest that shared values and interests between consumers and virtual

influencers can strengthen the trust relationship between them. Additionally, Physical Attractiveness and Social Attractiveness were found to have a positive impact on consumers' Perceived Characterizations. These findings align with the research of Ert and Fleischer (2020), Sokolova and Kefi (2020), Toma (2014), Masuda et al. (2022), Lee and Watkins (2016), Lou and Kim (2019), Zheng et al. (2020), Hook, Baxter, and Kulczynski (2020), and Schouten et al. (2020), which suggest that the physical and individual attractiveness of virtual influencers can strengthen the trust relationship between them and their audience, enhance the interaction between them, and positively impact the attitude toward the brand influencers endorse. However, this study found that Physical Attractiveness does not significantly and positively influence Brand Equity, which contrasts with previous research results (e.g., Liu and Zhang, 2019; Menon et al., 2001). Nevertheless, the study found that virtual influencers' Social Attractiveness can enhance the brand effectively, which aligns with Masuda et al. (2022) and Lieven (2016).

5.2 The Impact of Perceived Characterizations on Behavior Intention

The study found that Perceived Characterizations have a positive impact on consumers' Behavior Intention. Specifically, Trustworthiness was found to have a positive and significant impact on Purchase Intention. This finding is consistent with previous research results (e.g., Hsu et al., 2022; Lou and Kim, 2019; Wathen and Burkell, 2002), which suggest that a stronger trust relationship between consumers and virtual influencers can positively impact purchase decisions. Parasocial Interaction was also found to have a positive and significant impact on Purchase Intention, and it has complete and partial mediating effects between Attitude Homophily, Physical Attractiveness, and Purchase Intention, respectively, which aligns with Hsu et al. (2022) and Masuda et al. (2022). This suggests that the interaction between virtual influencers and their audience can positively impact purchase decisions, especially when audiences are attracted by virtual influencers and share similar values and interests. Brand Equity was found to have a positive and significant impact on Purchase Intention, and it has completed and partial mediating effects between Attitude Homophily, Social Attractiveness, and Purchase Intention, respectively, which aligns with Es-Safi and Sağlam (2021), and other research. This finding suggests that the social platform run by virtual

influencers can effectively improve Brand Equity and positively impact purchase decisions.

5.3 The mediating effect of Perceived Characterizations

The results of the mediator test showed that Trustworthiness has a complete mediating effect between Influencer Attributes (Attitude Homophily, Physical Attractiveness, and Social Attractiveness), which is consistent with previous research by Cheng, Chen & Huang (2006) and Soekmawati et al. (2022). This suggests that when audiences share the same values and preferences as virtual influencers, and are attracted to their appearance, their trustworthiness is positively impacted, which in turn affects their purchase decisions.

Additionally, Parasocial Interaction was found to have both complete and partial mediating effects between Attitude Homophily, Physical Attractiveness, and Purchase Intention, as supported by previous studies by Hsu et al. (2022) and Masuda et al. (2022). This suggests that when audiences are attracted to virtual influencers and share the same values and preferences, it motivates interaction between them, which has a positive impact on audience purchase decisions.

Finally, Brand Equity was found to have both complete and partial mediating effects between Attitude Homophily, Social Attractiveness, and Purchase Intention, as supported by previous research by Es-Safi and Sağlam (2021). This suggests that when audiences share the same values and preferences as virtual influencers and are attracted to the social platforms where they are active, it can effectively improve brand equity, further impacting audience purchase intentions.

In conclusion, this study highlights the important role of Perceived Characterizations as significant mediators between Influencer Attributes and Purchase Intention. The findings suggest that virtual influencers should focus on building their trustworthiness, fostering parasocial interaction, and improving brand equity to positively impact their audience's purchase intentions.

5.4 Suggestions

5.4.1 The impact of Influencer Attributes on Perceived Characterizations

This study shows that Influencer Attributes can effectively improve Perceived Characterizations, with Physical Attractiveness having the ability to increase

Trustworthiness and Parasocial Interaction of Perceived Characterizations. Based on these findings, we offer the following suggestions for Influencer Attributes:

(1) Attitude Homophily

Marketers should identify their target audience and create content that would interest them. They should also link their virtual influencer ambassador to brand identity.

(2) Physical Attractiveness

Marketers can design a virtual influencer that fits their brand image. For example, if it is a sports brand, they can design a virtual influencer with a toned or curvy body. Moreover, marketers could also conduct research on the appearance preference of the target audience to make the best choice.

(3) Social Attractiveness

Marketers must fully showcase the unique characteristics of virtual influencers to stand out from others. They can create a character with interesting background stories to catch the audience's attention.

5.4.2 The mediating effects of Perceived Characterizations

This study demonstrates that Perceived Characterizations play an important mediator role between Influencer Attributes and Behavior Intention. Hence, we suggest the following recommendations for Perceived Characterizations:

(1) Trustworthiness

Marketers should choose virtual influencers whose content is relevant to the industry of the brand. This would increase the audience's perception of reliability. Additionally, virtual influencers should showcase their expertise, and when the audience recognizes this expertise, it can not only enhance connections between the influencer and audience but also motivate the purchase intention of the audience.

(2) Parasocial Interaction

We recommend that marketers focus on improving the engagement rate, such as paying attention to current trends and frequently interacting with their audience. Furthermore, selecting opinion leader type virtual influencers can improve the interaction with the audience. In comparison to real celebrities with higher costs, having virtual influencers with lower costs can establish a friendship with the audience more easily.

(3) Brand Equity

Marketers should focus on enhancing brand association by inviting virtual influencers who match the brand image. Marketers could also establish the virtual influencer's image to meet the audience's preferences. Additionally, virtual influencers can show up on brand advertisements or online events to gain public attention and increase brand exposure.

5.5 Limitations of the study and recommendations for future research

This study provides industries with reference for using virtual influencers as a marketing strategy. However, due to limitations, the study offers advice for future research. Firstly, the survey design was limited due to the lack of resources available on virtual influencers, resulting in the use of studies on celebrities on social media as a reference. Future research should design surveys specifically for virtual influencers. Secondly, the study focused on VTubers, limiting analysis of the virtual influencer industry as a whole. Future research should expand to overseas markets to explore different virtual influencer trends, such as those in the Korean fashion industry.

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Innovation and Sustainability: Towards more Smart and Green Forms of Organization for Healthcare

Isabella Bonacci*

Universitas Mercatorum
Piazza Mattei, 10 Roma

Maria Zifaro

Universitas Mercatorum
Piazza Mattei, 10 Roma

* *Corresponding author*

Abstract

The paper aims to create the conditions to develop a smart model of work organization 4.0 able to generate sustainability and green logic through a multi-sectoral approach that exploits the central role that the working dimension assumes in the life of the urban community and in the organization of the city.
The methodology that we intend to apply is qualitative-quantitative in the sense that we will start with a first desk phase that aims to collect specific information, detailed, useful in the start-up phase and that will then be used to build the survey and will proceed with a longitudinal analysis.
The expected results of the research concern, first of all, the overcoming of the state of inconsistency and weakness on the subject of agile work and also the attempt to rationalize the economic and social impacts that this innovative approach entails.
The importance of this work lies in the possibility of building a structured SW implementation model that takes into account the different implications (economic, organizational and social) that this innovative approach to work generates. Our scientific and operational contribution is based on the possibility of creating new forms of work.
An innovative contribution of this paper appears to be the formulation of proposals and useful indications for change management policies and interventions in terms of new forms of work, in the sectors under analysis.
In particular, the paper, through the results of a qualitative-quantitative analysis will focus on the identification of critical issues encountered by employees in the implementation of SW and its impact in terms of individual and organizational performance.
That is, this dimension transversally intercepts all aspects of personal and collective organization, affecting the lives of individuals and families, the local economy, the quality of the environment, the demand for mobility, consumption, social relations and urban planning.

These aspects allow to consider the change that the SW generates with a logic of combination between the hard aspects of an organization and the soft ones, including the new innovative digital skills, IOT and the so-called soft skills.
The overall results of the survey are intended to describe a dynamic process that begins to rethink even the procedures and tools of organizational action, within which the relationship with employees is increasingly placed at the center of the design.
The increase in the quantity and quality of time due to the lack of home-work journeys puts people in a position to experiment with new daily forms of re-synchronization of work commitments with family and personal needs.

Keywords –Smart Working, Covid19; Organization, Healthcare

Paper type – Practical Paper

1 Purpose of the research

Recent socioeconomic and technological changes in business environments have enabled new ways of working based on flexible ways of working and extensive use of information technologies that support employees to work potentially at any time and space (Lee et al., 2021). Added to this is the global health emergency that is paralyzing most work activities, with dramatic impacts on work and employment (Lee et al, 2020; Diab-Bahaman & Al-Enzia, 2020) globally. Such approaches are generally referred to as "smart working" practices (Andy et al, 2020; Eberhard et al, 2017).

The SW model emerged in Italy during 2014-2015 and finds new vigor , shaping a new philosophy of work. SW has been defined as an agile and dynamic way of working that leads to high performance, higher productivity and better job satisfaction (Nicholls et al 2020; Ingusci et al. 2020). Job satisfaction is one of the most commonly reported outcomes of the SW, but doubts remain regarding the benefits and disadvantages of working remotely versus working in a collocated environment (Fedorova et al, 2020).

Our argument aligns with the existing literature on the consequences of SW, which identifies several mechanisms by which SW affects individual outcomes, including job satisfaction. In particular, it is possible to conceptualize the mechanisms / variables discussed in the literature on SW according to three conceptual blocks:

- the individual and psychological aspects associated with the adoption of the SW;

- the work environment created;
- used for the SW (Li et al , 2021).

We rely on this framework to define the SW on the basis of a series of variables that have as their background the relationship SW-job satisfaction to define a "relatively" new construct: smart working satisfaction (SWS).

Organizations have the opportunity to leverage SW to build true working ecosystems (Rasheed et al, 2021). The word ecosystem describes an open, interconnected and dynamic context, the opposite of most office work environments, traditionally characterized by closure, separation and stillness (Tonis et al, 2021). It is a question of breaking down the barriers that exist today on several levels and crossing borders to acquire freedom of movement and action, that is, being called to conquer a new working space that evokes the characteristics of openness, interconnection and dynamism typical of an ecosystem. Agile work changes the entire organizational system by taking inspiration from these very aspects, and without organizations committed to transparency, trust-oriented leaders and fully accountable employees, this change cannot even begin. For this reason, working in an agile way presupposes a very mature approach to work, eliminating the habits and comfort zones linked to the static nature of work (Tonis et al, 2021).

This contribution proposes is to analyze how this new approach to work can also be applied to Health Organization (HO). The SW can represent an opportunity for the HO in terms of rationalization of public resources, it can promote the use of the most innovative digital technologies representing a level for digital transformation and the development of digital knowledge, it can also reduce forms of "physiological absenteeism. "(Tripi & Mattei, 2020). It also represents a lever for change for organizations and their workers because it allows them to go beyond compliance, favoring collaboration, planning, management and results (Xiao et al, 2021).

Health emergencies and the need to manage territorial routines have led to the indiscriminate use of digital technology, generating new and increasingly smart forms of communication (Cheng et al., 2020). By applying our framework to public sector organizations in general, our research questions can be further specified:

> *(RQ1) Can implementing SW in complex systems such as Ho create innovation ecosystems?*

(RQ2) Do the workers in these sectors identify SW as a new organizational approach or just an alternative way to manage the emergency of the COVID period?

(RQ3) Does the SW experience in pandemic conditions open horizons for future applicability?

From these considerations it emerges that the objective of the research becomes to investigate the variables that underlie the SW as an organizational approach and how to measure worker satisfaction.

2 Theoretical framework

Several models have been structured during the years to better approach SW application, implementing adequate standards to gain benefits from this non-traditional working-model (Kaback, 2021). The concept of SW finds its origin in the literature stream studying the application of non-traditional and flexible work practices and locations for carrying out work (Fedorova et al, 2020). Authors assert that organizations strive to provide flexible work arrangements and more cost efficient and creative office environments in order to support competitiveness and employee productivity without decreasing job satisfaction (Devotto et al, 2019).

Academically, it is recognized that through the application of SW it would be possible to optimize engagement, motivation, satisfaction, and even perceived well-being at work (Angelici & Profeta, 2020). These effects would be possible if satisfaction levels matched professional and private aspects. In particular, job satisfaction is one of the most outcomes of smart working (Fedorova et al, 2020). The implementation of SW provides a number of benefits for the worker and for the organization to which it belongs ranging from productive enhancement, to the achievement of a high level of well- being (Health), to a more sustainable vision of their work (Green) finally, to an enhancement of social aspects(social) (Nicholls, 2020). For these reasons, SW is defined as an organizational approach (Spicer, 2020).

This might also be perceived by employees as reflecting or allowing a greater fit between themselves and their job, which is an aspect of positive work role adjustment (Seepana, 2021; Weintraub et al., 2021). Altogether, these benefits of SW lead us to assume that Smart –Working Satisfaction (SWS) could be shaped as the ability to feel positive emotions in regard the job performed under the SW

application (Lee et al. 2021): a combination of psychological, physiological and environmental circumstances referred to the attitude and feelings people have to be satisfied of the SW adoption. Our framework – according to some previous studies (Fedorova et al, 2021; Lee et al, 2021) investigated the consequences of SW – tries to identifies the factors through which SW affects individual outcomes, especially job satisfaction. These factors in our conceptual model represent three conceptual themes/blocks within the SW literature:

1. the individual and the psychological aspects (micro level)
2. the social/relational dimensions (meso level)
3. the resources and the tools available for SW (organization/context) (see Table 1).

Tests on several models conducted in previous research (Nicholls et al, 2021; Rainero & Modarelli, 2021.) indicated that the factors influencing the SWS largely represent benefits rather than disadvantages of smart working. We build upon this literature (Lee et al. 2021; Rainero & Modarelli, 2021) by proposing factors and dimensions for each level of analysis to better explain the construct of SWS.

Table 1 – Variable of the three level

Level	**Definition of the level**	**Variables**
	It is referred to the individual and psychological aspects associated with the SW adoption	Job autonomy Work-life balance Work m**otivation**
Meso	It is referred to the relationship and the social dynamics involved in SW adoption	Relationship with colleagues Communication Emotions Stress
Macro	It is referred to the resources, the tools and more in general the work environment created and used for SW	Work hour flexibility ICT Performance/productivity Career opportunities

These variables arising from the 3 levels through a structural analysis will be combined to understand how they interact but also what impact they have on the worker in SW.

3 Research methods

The objective of the research becomes to investigate the satisfaction that an innovative model of SW can generate, analyzing what may be its predictors and - in particular - if it is possible to define a model in relation to the weight of these aspects in determining a successful experience of SW in HO. In order to answer the question of search with a level of detail and sufficient reliability it has been necessary to involve a greater number of respondents, in order to verify if the model can express one its stability also with particular target like the healthcare sector.

The sample, therefore, is of 1252 people belonging to the health sector. Of these, they have been held valid for the successive analyses only the subjects that have answered to have carried out activity of SW. Ninety cases were excluded.

As a result, there were 1162 participants, of whom 41.8% were men and the remaining 58.2% were women. The age of respondents ranged from 22 to 65 years, with a mean age of 43 years and 5 months.

Data were collected through a CAWI survey conducted in 2020-2021. With specific reference to the educational qualifications of the participants, 0.6% have a junior high school diploma, 1.6% a vocational school diploma, 22.2% a high school diploma, 48.0% a bachelor's degree and 27.6% a post-graduate master's degree or doctorate.

The geographic distribution is represented: 26.96% from the Northwest regions, 3.62% from the Northeast, 51.59% from the Center, and 17.83% from the South and Islands. 75% of the sample performs a clerical role and, in particular, 45.4% define themselves as conceptual employees, 29.6% as executive, official or managerial employees, 8.5% as freelance professionals, 8.1% as executives and 3.8% as entrepreneurs.

The remaining 4.7% of respondents indicated something else.

With respect to company size, 7.1% of respondents work in companies as less than 5 employees, 4.1% between 5 and 10, 14.6% between 10 and 50 employees, 11.7%

between 50 and 150 employees, 22.8% between 150 and 1,000, 17.0% between 1,000 and

10,000, and 22.7% in companies with over 10,000 employees.

3.5% of respondents indicated that they performed less than 20% of their time in SW, 10.6% between 20% and 50%, 18.1% between 50% and 80%, and 67.8% over 80%.

The survey returned significant data in terms of job satisfaction, as information was provided by participants expressing their perceptions, attitudes and levels of both physical and mental health in using smart working as a new organizational approach in the company.

The questionnaire design included an introductory section with data useful for reclassification.

The study represents a pilot survey to be replicated later in an absolute fashion in the health care sector.

To measure the items, we used the five-point multi-item Likert scale (Krosnick et al 1997). Specifically, the items identify latent variables. A latent variable is a hypothetical or unobservable concept that we measure using a set of observable variables.

The selected measurement items were validated by the literature and previous empirical studies, and slightly adapted to make them more applicable to the context of our study.

Subsequently, the exploratory data analysis was extended by introducing more sophisticated techniques, such as structural equation modeling, to gain a more detailed understanding of the issue being analyzed.

Structural equation modeling (SEM) is a technique that combines factor analysis and regression. In this context, we use partial least squares structural equation modeling (PLS-SEM; Hair et al. 2019), which is variance-based, to test the conceptual model. This decision is supported because PLS has been shown to be effective when research is primarily exploratory and predictive (Nelson et al., 2016; Ringle, Wende, & Becker, 2014; Hair et al., 2019).

Finally, they were asked to indicate whether - prior to this experience - SW experiences existed at their company and whether they had participated in them.

24.0% indicated that they had done so, but in an incidental and non-formal way, 35.8% in a formalized way, and 40.2% had not participated in SW experiences.

The subsequent application of linear regression formalises and solves the problem of functional relationships between variables measured on the basis of extracted sample data

Table 2 Presence of formalized or non-formalized SW actions prior to Covid-19

	N	%
Before Covid-19, had you already had experience with smart working?		
Yes, but incidental and not formalized	279	24,0%
Yes, formalized	416	35,8%
No	467	40,2%

The model that was developed aims to investigate the links and their relative strength between latent constructs that determine Smart Working Satisfaction (henceforth SWS for short) and SWS for the worker. The structural model allows a target latent variable (SWS) to be determined by defining the impact of other major constructs (the determinants of SWS).

The determinants constructed by the literature review are as follows: 1. Job autonomy;

2. WLB; 3. Work motivation; 4. Relationship with colleagues; 5. Communication; 6. Productivity/Performance 7. Emotions; 8.. ICT; 9. Career opportunities; 10. Work hour flexibility

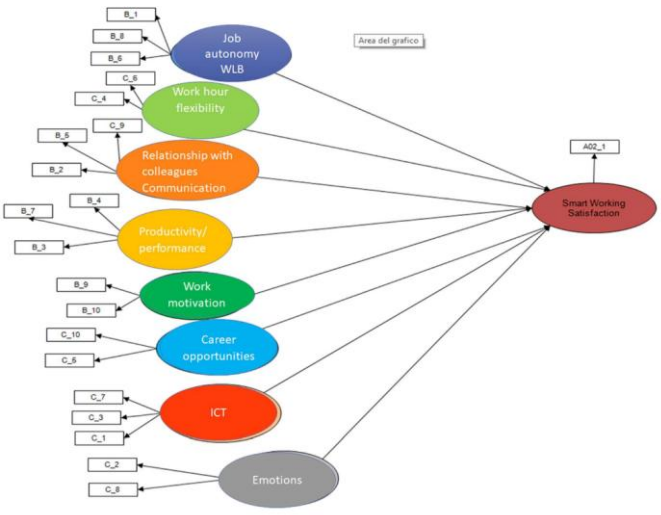

Figure 1 The hypothesized Model for the SWS

In the hypothesized model, the SWS is the variable objective while, the other variables are considered the determinants of the SWS

Based on this model, the following assumptions can be made:

H0 = No relationship between the latent dimensions and the SWS;

H1= Presence of one meaningful relation between the dimensions of the model and the SWS

In operational terms, the two hypotheses can be considered verified if an R2 greater than 0.40 is achieved, the hypothesis will be rejected with an R2 less than or equal to 0.40.

4 Results

Therefore to assess the degree of influence of the variables on the SWS, a linear regression analysis was performed. The SWS was used as the dependent variable and the questionnaire items as the independent variables. The high level of collinearity between variables was analyzed using SEM to assess causal relationships between latent concepts (VL) from a set of real indicators defined as Manifest Variables (VM). After the analysis of the determinant indicators of SWS, the 8 determinants of SWS were identified i.e. 8 latent variables that the literature has validated, each reflected in a number of indicators between 2 and 3 (derived from the questionnaire questions and detected through the field survey).

Table 3 Association between manifest and latent variables

Variabili latenti	**Variabili manifeste**
Personal freedom and balancing with private life	Smart working makes me live more freely
	Thanks to smart working I can manage my work commitments with more freedom
	Smart working has improved my work-life balance
Managing emergencies and schedules	With smart working, urgent requests from my bosses and colleagues have not increased
	During smart working I am not often contacted outside working hours
Relations and communication with colleagues and the company	Smart working allows me to have a better relationship with my colleagues
	With smart working I have perceived greater trust in me on the part of my colleagues and the company
	Smart working does not make communication with colleagues very difficult

Goals and job performance	Smart working enables me to better achieve my professional goals
	My work efficiency is increased thanks to smart working
	My work performance has improved thanks to smart working
Motivation and job satisfaction	Smart working has increased my work motivation
	My job satisfaction has increased thanks to smart working
IT tools and spaces for managing smart working	I have adequate tools to be able to work in smart working mode (e.g. computer, software, adequate screen, headset, microphone, adequate Internet connection)
	I have adequate space in my home to be able to work in smart-working mode
	I am able to use digital tools for smart-working (e.g. video call and document sharing)
Emotional consequences of smart working	Smart working does not increase my sense of loneliness much
	Smart working, for various reasons, does not increase my stress
Influence on career and leader evaluation in the company	My bosses and superiors have a positive opinion of people who want to work in smart working
	Smart working cannot penalise the career of those who choose it as a way of working

Responses were recoded, classifying them by response type.

Table 4 Synthesis and classification of the answers to the open question

	N	**%**
Communication/Relationships/Colleagues	96	37,9%
Working hours/Right of disconnection	38	15,0%
Loneliness/Allienation/Exclusion	35	13,8%
Inadequate setting/home	35	13,8%
Increased workload and working hours	34	13,4%
Productivity/organisation/modality	33	13,0%
Work-life balance	28	11,1%
Inadequate work tools	27	10,7%
Presence of children at home to look after	22	8,7%
Quality of connection	15	5,9%

37.9% indicated the category related to Communication and/or Relationship with colleagues. 15.0% identified issues related to missed work hours and lack of right to disconnect.

13.8% identified the issue of loneliness, alienation and marginalization. Similarly, 13.8% complain about the inadequacy of their SW setting at home. 13.4% link their dissatisfaction to their increased workload and extended work

hours. 13.0% report having reduced productivity, or organizational or mode-related problems.

For 11.1%, dissatisfaction is related to a lack of work-life balance. For 10.7% the work tools are inadequate (and for 5.9% the problem is linked to the quality of the connection), while for 8.7% of respondents dissatisfaction is linked to having to look after young children at home.

4.1 Linear regression analysis

The items of the questionnaire present strong internal correlations, which explains the contribution of each dimension in analyzing the variability of scores related to the level of satisfaction with SW. For this reason, a multiple regression was performed. The regression was found to be significant ($F(20,1127)= 72.97$; $p<0.01$), with an adjusted R2 value of .557.

Table 5 R values of the regression model

Modello	R	R-quadrato	Adapted R-square	Estimation std. error
1	,751[a]	,564	,557	,594

From the analysis, 10 items emerge as predictors of satisfaction. Of which 8 are positive and 2 are negative.

These are positive predictors of satisfactory SW (the Standardized Beta coefficient):

Smart working makes me feel more free/ WLB (0.138), Smart working has improved my work-life balance (0.104) o WLB, I have adequate space in my home to be able to work in smart working (0.084) o Work hour flexibility.

My work effectiveness increases due to smart working (0.123) o Productivity/performance, I have the appropriate tools to be able to work in smart working mode (0.075) o ICT, My work performance is improved due to smart working (0.113) o o Productivity/performance, Smart working allows me to better achieve my professional goals (0.082) e I am able to use digital tools for smart-working (0.042) o ICT.

These are negative predictors: During smart working, for various reasons, my stress increases (-0.069) o Emotions and Smart working makes it very difficult to

communicate with colleagues (-0.135) o Relationship with colleagues Communication.

Table 6 Correlation matrix between manifest variables and latent variables

Item	Job autonomy Work-life balance	Work hour flexibility	Relationship with colleagues Communication	Productivity/ performance	Work motivation	ICT	Emotions-Stress	Career opportunities	Smart Working Satisfaction
B_1	**0,8809**	0,2094	0,4623	0,5765	0,6228	0,2413	0,4215	0,0424	0,5536
B_6	**0,8479**	0,1689	0,5002	0,5972	0,6020	0,2885	0,3831	0,0810	0,5186
B_8	**0,8782**	0,2593	0,4504	0,5063	0,5675	0,2684	0,4510	0,0535	0,5336
C_4	0,2102	**0,8843**	0,1861	0,1225	0,1668	0,0397	0,3136	0,2801	0,2057
C_6	0,2185	**0,8643**	0,1630	0,0568	0,1124	0,0722	0,3714	0,2503	0,1909
B_2	0,4615	0,1117	**0,7718**	0,5794	0,6046	0,2529	0,2414	0,1560	0,4513
B_5	0,5054	0,1301	**0,8517**	0,6404	0,6757	0,2678	0,3999	0,1053	0,5003
C_9	0,2690	0,2350	**0,6883**	0,3424	0,3349	0,2202	0,4965	0,2811	0,4051
B_3	0,5894	0,0964	0,6387	**0,9005**	0,7593	0,3007	0,4210	0,1001	0,5877
B_4	0,5861	0,0861	0,6142	**0,9177**	0,7418	0,3301	0,4102	0,0778	0,6004
B_7	0,5859	0,1018	0,6186	**0,9165**	0,7526	0,3155	0,3646	0,0568	0,5923
B_9	0,6271	0,1513	0,6643	0,7684	**0,9391**	0,2936	0,4216	0,0992	0,5775
B_10	0,6664	0,1513	0,6698	0,7823	**0,9431**	0,3187	0,4649	0,1076	0,5971
C_1	0,1534	-0,0608	0,1771	0,2150	0,1573	**0,5817**	0,0892	0,0093	0,2172
C_3	0,1968	0,0408	0,2124	0,1936	0,1666	**0,7426**	0,1478	0,0756	0,2667
C_7	0,2838	0,1144	0,2833	0,3186	0,3381	**0,8087**	0,2777	0,0959	0,3610
C_2	0,3719	0,2294	0,4750	0,4108	0,4486	0,1961	**0,8449**	0,1858	0,4014
C_8	0,4466	0,4312	0,3514	0,3346	0,3551	0,2422	**0,8565**	0,2315	0,4161
C_5	-0,0368	0,2317	0,0765	-0,0492	-0,0482	0,0532	0,0195	**0,5120**	0,0376
C_10	0,0824	0,2805	0,2294	0,1054	0,1317	0,0890	0,2653	**0,9805**	0,1640
A02_1	0,6162	0,2270	0,5868	0,6511	0,6242	0,4034	0,4806	0,1573	**1,0000**

The table shows the highest correlations between each manifest variable and the different latent variables, echoing the structure of the model represented in Figure 1. The clear block structure highlights the monofactorial nature of each manifest variable that is more strongly correlated with the concept it is intended to measure than the others however present in the model.

To answer the research question we found it useful to preliminarily investigate the dimensions that influence satisfaction with the Smart Worker.

The value of the linear determination index R2 can be interpreted as the percentage of variability of the respective latent variable explained by the model, i.e. the goodness of the model in predicting the scores of the latent variable. An R2 value greater than

0.40 confirms the first hypothesis tested through the model i.e., the ability of the determinant latent variables to explain satisfaction from a SW experience.

The R2 relative to the model is 0.54, a satisfactory value and above the threshold limit (see Hair, et al 2019).

With reference to the specific objective of the research, related to the possibility of empirically verifying the goodness of a model that linked the items found in the literature to satisfaction with SW, the analysis of the data confirms hypothesis H1, that is, the presence of a significant relationship between the dimensions of the hypothesized model and SWS.

We can therefore reject hypothesis H0, i.e., no relationship between the latent dimensions and SWS.

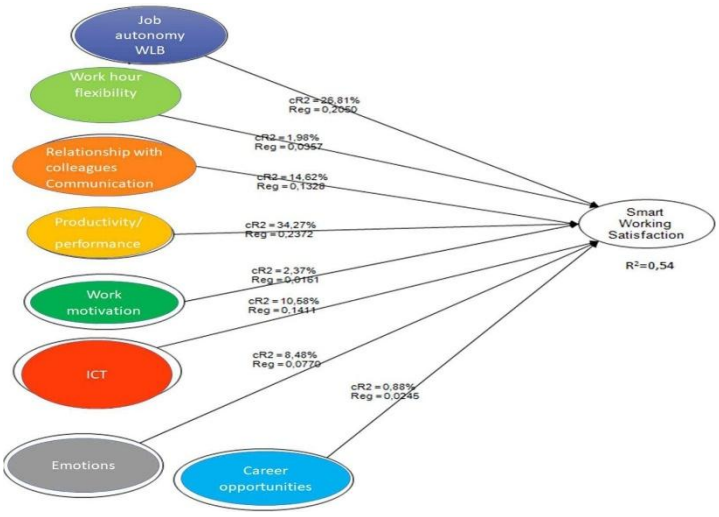

Figure 2. Model of overall SWS

As highlighted in Figure 2 all variables in the model contribute to determining SWS. The two most important factors that emerge are the achievement

Productivity/Performance (reg=0,2372), in the second place Work autonomy, WLB (reg=0,2050), in the third place ICT to manage the SW (reg=0,1411) and finally among those significant the Relationship with colleagues Communication (reg=0,1328). The other variables, while having a positive value, express a less significant contribution in the constitution of the SWS score. As is evident from the calculation of the scores, an increase of 5 points in the total value of the "Productivity/performance" scale produces an increase of 1.18 points in the SWS and an increase of 5 points on Personal freedom and balance with private life of 1.02 points. The other dimensions, with the same increase, produce an increase in SWS of less than unity.

From the analysis of the average scores and the variability of the latent variables reported in Table 6, it can be seen that overall the SWS reaches a fairly high score of 76.4 expressed on the 0-100 scale and that therefore the smart worker considers himself satisfied and the choice of continuing to work from home even in a non- emergency situation particularly attracts him, as long as other determinants such as mental well-being (health dimension) and the sense of community involvement (social dimension) are satisfied in addition to family balance.

Table 7. Mean scores and variability of latent variables in the SWS model

Items	**Average**	**Deviazion std.**
Job Autonomy - WLB	73,5527	25,9854
Work hour flexibility	46,8108	29,0580
Relationship with colleagues Communication	52,8494	22,9556
Productivity/performance	62,7659	26,9994
Emotions	58,5649	28,8958
ICT	74,0576	22,9553
Work motivation	59,0561	28,0912
Career opportunities	56,7439	28,1696
Smart Working Satisfaction	76,4415	22,3551

As far as the latent variables determining the SWS are concerned, the highest scores expressed by the SW workers interviewed concerned the availability of ICT to manage the SW (74.05), WLB thanks to the SW (73.55) and Productivity/Performance (62.7).

Less positive was the evaluation of Work Hour Flexibility, with workers complaining of an increase in urgent tasks and calls outside normal working hours, together with Relationships with colleagues Communication in SW, which do not completely satisfy the SW workers interviewed and therefore do not represent attractive factors.

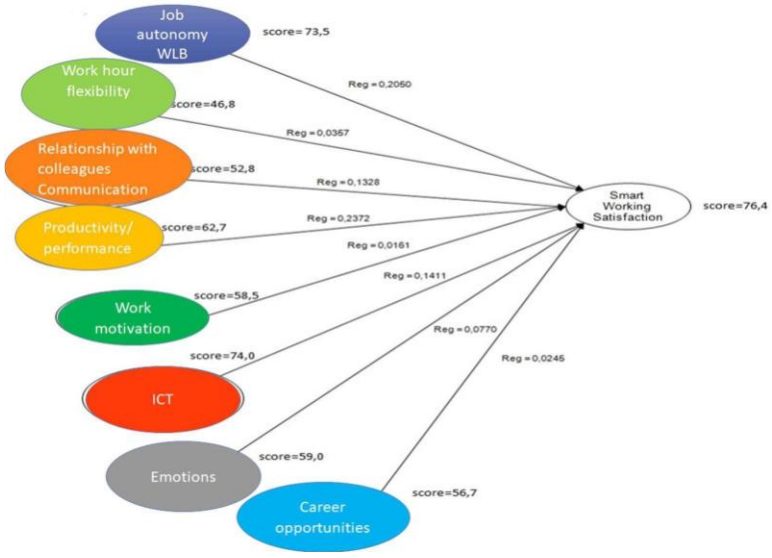

Figure 3 Latent variable scores in the SWS model.

The Smart Working Satisfaction score can be calculated as a weighted sum of the scores of the latent variables that determine it . The PLS algorithm calculates these values, which correspond to the impact coefficients.

Smart working Satisfaction =0.94 + 0.20* Job autonomy, WLB + 0.03* Work time flexibility +0.13* Relationship with colleagues communication +0.23* Productivity/Performance+ 0.01* Work motivation + 0.14* ICT + 0.07* Emotions + 0.02* Career possibility.

An increase in a latent variable that determines SWS corresponds to a total increase in SWS. Figure 3 calculates all potential increases in SWS as the other determining variable changes by 5 points.

It is important not to underestimate that in addition to checking which latent variables have the greatest impact on SWS and which indicators weigh most heavily in the construction of these concepts, it is also necessary to take into

account the average scores calculated for the latent variables and the average scores observed for the items.

Only the joint reading of these two pieces of information (impacts and performance) makes it possible to identify the so-called levers for improvement, since they suggest on which critical areas to intervene, with what urgency and by means of which actions. Basically, if companies or public decision-makers wanted to implement worker satisfaction in SW, they could make use of an intervention matrix (figure 3) that represents the synthesis of this information as well as, a simple and valid tool to support the diagnosis and identification of corrective and improvement actions.

5 Discussion and conclusion

The recent health emergency together with the information that emerged from this research, certainly represent a valid opportunity to question the criticalities that for years have slowed the adoption of SW in various work environments both public and private (Rainero & Modarelli, 2020).

Starting from the research questions (see Par.1) and in line with the objective (see Par.1), this research, despite its incompleteness, highlights a new operational logic of smart working, to be considered not as a strategic tool that organizations put in place with a few simple technological devices, but as a real organizational revolution (Xiao, et al., 2021).

The analysis presented contributes to extending the literature on SW in several ways: first, with the help of the structural equation model that allowed us to test the validity of the research hypotheses. It emerges that the H0 hypothesis is not confirmed, as it has been shown that there is a strong correlation between the identified latent variables and SW satisfaction. This result attributes meaning and value to the work performed and their ability to experiment with new ways of performing tasks and duties through determination and flexibility (Xiao, et al.,2021).

When a worker feels engaged and attaches value to their task, they will be more likely to create a satisfying and challenging environment (Hodder, 2020; Diab-Bahaman & Al-Enzia, 2020). This proactive behavior acts as a protective factor from the onset of burnout and emotional exhaustion (Brooks, Webstar, Smith, et al.2020).

The research, therefore, highlighting the existence of positive relationships between the 8 variables that the literature has given us, also confirms the H1 hypothesis and enriches the value of the SW by extending its scope to economic and social scenarios of crisis and emergency management.

The survey, if on the one hand confirms the robustness of the epistemological choice made and the fundamental role of SWS, on the other hand adds a piece to the literature on the subject, since it underlines how worker satisfaction represents a positive catalyst for productivity (Seepana, Huq, and Paulraj, 2021). W becomes a true organizational approach characterized by a combination of different dimensions, useful to meet the needs of workers, allowing them to more easily reconcile work time with personal needs and flexibility, achieving benefits in terms of individual and organizational performance as well as well-being and health (Spicer, 2020).

Taking up the classification that the literature review has allowed to formalize emerges from the empirical analysis, an enrichment or rather a reinterpretation of the same variables by adding the dimension of reference.

The pandemic has generated many psychosocial consequences, hitherto underestimated, to which aspects related to isolation and bad relationships have been added, highlighting the importance of the social and health dimension of the SW (Tripi & Mattei, 2020). These dimensions cross all levels of the organization (micro, meso, macro) and, by latching on to latent variables, impact SWS (AlQershia, 2021).

The least satisfied are the workers who have had a previous experience but occasional and little formalized.

In the scenario of isolation and agile work imposed by the health emergency, the SWS can take on the role of a catalyst for the creation of a new model of work and protection from work sickness, considering both its impact on decreasing emotional exhaustion and its role as a mediator between the meaning of work and motivation to work (Seepana, Huq, and Paulraj, 2021).

In fact, it is noteworthy that the direct relationships between the individual variables are insignificant, while with the mediation of the SWS, they assume significance. This result is beyond interesting as the mediating function of the SWS has only recently been explored and highlights its role in enhancing the relationship between job meaning and motivation (Devotto, Wechsler, 2019). Furthermore, the finding is in line with studies suggesting the role of SWS as a

key element in decoding resources into elements of well-being (Seepana, Huq, and Paulraj, 2021).

Reduced social relationships (including those established in the workplace) are known to be risk factors for the onset of conditions such as depression and burnout (Kasbuntoro, Maemunah, Mahfud, 2020).

Smart Working radically changes the organizational structure of the company, corporate culture, leadership systems, employee relations, the use of digital technologies, communication and the corporate workplace (Passmore, Hemming, McIntosh, Hellman, 2020). This innovative ecosystem has the potential to generate a variety of benefits for workers, the company, the environment, and society.

Smart workers are more satisfied with their work than traditional workers not only that, also supported by research data, agile workers are more satisfied with their relationships with colleagues and superiors, and want to stay in the company longer (Fedorova, Koropets, Menshikova, 2020).

Through the practice of Agile Work it is therefore possible to generate benefits that significantly improve the psycho-physical balance of the worker with important repercussions in both private and working life (Dousin, Collins, Bartram, Stanton, 2020).

The survey has returned an important aspect of Smart Working: a high level of worker satisfaction.

The research presented here, in addition to relevant theoretical developments, can provide important operational implications for organizations. The support to the worker through improvement actions to ensure levels of well-being and contain work- related stress, is an important contribution to the testing of positive experiences and improvement in terms of quality of working life.

6 Limitations and implementation

The study, while original, has some limitations. Limitations include the use of an online, self-report instrument, which exposes the risk of social desirability in responses. In addition, the assessment of some items, such as emotionality, reflects an individual's own perception and is not subject to objective evaluation.

The measurements described through latent variables, and specifically emotional exhaustion and meaning of work, although reflecting extremely broad and complex concepts, were captured with few items. Further studies could use

more comprehensive tools, methods, and methods suitable for capturing more specificity of these latent constructs. Another aspect to be taken into account concerns the heterogeneity of the sample involved especially in those characteristics for which there does not appear to be a balance so future studies could try to balance any disaggregation variables. Measuring satisfaction with the SW exclusively with one item and not with a multidimensional measurement scale, for example based on the basic components of attitude would have allowed a more precise measurement of the phenomenon and - certainly - helped to explain a greater share of the variance.

The main limitation of the research is the lack of a representative sample. Participants however numerous, were identified through convenience sampling, which does not guarantee solid representativeness and generalizability of the data. The measurement of satisfaction with SW exclusively with an item and not with a multidimensional measurement scale, for example based on the basic components of attitude (emotion, cognition ...) would have allowed a more accurate measurement of the phenomenon and - certainly - helped to explain a greater share of the variance.

The research was carried out in a particular historical period, characterized by exceptional conditions. In particular, this aspect could have influenced the respondents who judged the experience in "exceptional" terms and not in stable and structural terms; this poses a major limitation on the possibility of generalizing the results even over different historical periods.

From the point of view of application, the research raises many points of interest that will be the subject of further study in subsequent research.

First of all, in relation to the values of some dimensions, such as the right to disconnect, it would seem to emerge strongly a focus of people on other dimensions of growth and development of the tool.

In addition, the time horizon of the research concerns the first period of total Italian lockdown, an interval in which the exceptionality of the situation forced many workers to confront new circumstances. A different time frame might lead to different conclusions. Finally, although the Structural Equation Model considers the presence of numerous psycho-social factors that can influence the expression of personal resources, work resources and work demands, the specific objective of the study in question is to explore, taking as a theoretical frame of reference and as a reading of the professional contexts, the SEM model (MES, Structural Equation Model) to investigate the relationship between the 8 variables and the

relative strength of the latter among latent constructs that determine the Satisfaction from Smart Working and the SWS for the worker.

A first aspect concerns the possibility of implementing a longitudinal research design in the continuation of the study, so as to consider individual and organizational variables and their sustainability over time, with a focus on workers' adaptive capacities in relation to economic-social changes (Ingusci et al, 2019; Van Wingerden J, Poell RF. 2019). It would be useful to replicate the study, overcoming the limitations outlined above, on a larger sample characterized by a random extraction of respondents and also including segments of the population at risk of exclusion (due to the methodology adopted).

In addition, the research could be developed through the realization of qualitative interviews with the central or prototypical subjects of the clusters identified in order to analyze - through more exquisitely qualitative methods - any additional variables not sufficiently analyzed by the current research model and structure.

Also among future developments, a perspective of regard could be referred to the testing of interventions for the promotion of SWS in organizations, not only as activities to support well-being in ordinary times, but as actions of stress prevention and management of risks and emergencies (Fedorova, Koropets, Menshikova, 2020).

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A Spatial Decision Support System for the Knowledge and Valorisation of Cultural Heritage in Small Towns: Method and Application to a Case Study

Pierfrancesco Fiore*

Department of Civil Engineering
University of Salerno
Via Giovanni Paolo II, 132 - 84084 Fisciano (SA), Italy

Michele Grimaldi

Department of Civil Engineering
University of Salerno
Via Giovanni Paolo II, 132 - 84084 Fisciano (SA), Italy

Emanuela D'Andria

Department of Civil Engineering
University of Salerno
Via Giovanni Paolo II, 132 - 84084 Fisciano (SA), Italy

Giuseppe Lombardi

Ingegnere, Project Manager
Via Baccanico, 43
83100 Avellino, Italy

* *Corresponding author*

Abstract

This paper proposes a method for recognising the elements of cultural interest located in inland areas and disseminating the information by a tool based on the data collection and organisation methods. This is done through the use of GIS (Geographic Information System), which makes it possible to map, manage and analyse a whole series of information, guaranteeing better knowledge and communication, as well as better management of decision-making processes. The application to the case study concerned the Province of Avellino as a pilot area, but it should be noted that the validity of the proposed methodology lies in the possibility of replication to any other context. The versatility of this tool can provide useful guidelines to those who wish to know,

communicate or intervene on the surveyed buildings/assets, which from time to time will become available through the databases implementation.

Keywords – G.I.S, S.D.S.S., inland areas, valorisation of cultural heritage, small towns

Paper type – Academic Research Paper

1 Introduction

The depopulation of small towns in inland areas has reached significant dimensions, especially in recent decades, with a strong impact on demographic, social and economic balances and, consequently, on the preservation and protection of a vast cultural, natural and landscape heritage of the territories. The interest in the wide-ranging cultural heritage, both tangible and intangible, is countered by the logic of globalization, homogenization and, above all, the drive of economic interests, which increasingly endanger factors related to memory and identity. Therefore, it is essential that the enhancement strategies take on the purposes of "knowing, preserving and valuing" the existing cultural heritage, according to what has been defined-along with "social," "environmental," and "economic" value-the fourth principle of sustainability, namely the "cultural" one (as highlighted by Rio+20 and by the United Nations Habitat World Urban Forum in Naples in 2012 and in Medellin in 2014).

The proposal of this paper is aimed at the re(knowledge) of such artifacts and the easy dissemination of information, through a tool based on the rational ways of collecting and organizing a large amount of data, made possible through the use of GIS.

The Geographic Information System makes it possible to map, manage and analyze a whole range of data, integrating them with all kinds of descriptive information. The advantage is certainly better knowledge and communication, as well as better management of decision-making processes.

Experimentation on a case study was useful in identifying the effectiveness of the proposed tool and offered a starting point for possible linkage with other projects already in place in order to create a shared system of quick reference information.

2 Materials and Methods

2.1 Spatial Decision Support System

The The concept of Decision Support System embraces a plurality of meanings (Sharda et al., 2015). A DSS involves three basic components (Andrew, 1991).

The *Database Management Subsystem* - which includes a database that contains relevant data for the class of problems for which the DSS was designed - and the Database Management System (DBMS), which is the software that manages the database.

The DBMS separates users from the physical aspects of database structure and processing. It should also be able to inform the user about the types of data available and how to access them.

The *Model Management Subsystem* - This subsystem includes a library of models (Model Base) related to science, statistics, management, and other models that provide the DSS with analytical capabilities.

The *User Interface Subsystem* - This subsystem covers all aspects of communication between the user and the different components of the DSS. Since such users are often managers who have no computer training, DSS must have intuitive and easy-to-use interfaces.

These interfaces help in building the model and interacting with the model, obtaining detailed information and recommendations from it. The purpose of a user interface is to improve the system user's ability to use and benefit from the DSS.

2.2 Methodology

The methodology is divided into two macro-phases.

The first macro-phase involves the following steps:

a) Choosing the survey area;
b) Subdivision into travel axes within the chosen area;
c) Choice of the model axis;
d) Identification of municipalities along the chosen axis;
e) Focus on one of the historic towns along the axis, as an example.

The second macro-phase is structured as follows:

f) Identification of buildings of historical-architectural interest (palaces, churches, convents, etc.), rural architecture (farms, mills, votive shrines, etc.) and cultural areas (archaeological areas, historic gardens, parks, etc.) present within the reference municipality;
g) Inclusion of the surveyed data, by means of Q-GIS software, within routes differentiated by thematic areas;
h) Exposure of a package of information useful for place knowledge (the actual data base of geo-referenced information).

The implementation of these steps involves the use of data integration techniques based on I datacubes (or data cubes). The latter are a type of structure, in which data are stored in multidimensional arrays (nD arrays); the data contain one or more spatial or temporal dimensions. Datacubes provide an effective way to apply analysis on spatiotemporal data, where the data incorporate both raster and vector data along with potentially other information.

3 Application

The work was approached by taking the province of Avellino as the reference hub, but it is worth pointing out that the validity of the proposed method lies in the possibility of application to any other context, supplementing the amount of data gradually.

The experimentation covered a test area in the Province of Avellino. More specifically, axes of interest were chosen in light of the ancient main arteries connecting the city of Avellino and the surrounding area, and thus referring mainly to provincial and state roads.

These in fact, although partly replaced by the construction of road infrastructure that can guarantee a certainly faster and more efficient mobility, represent the connecting routes that allow a wider and deeper knowledge of the crossed territory.

With the help of the Google Earth Pro program, a complete overview of all identified axes was made:

- Axis A1) Avellino-Salerno
- Axis A2) Avellino-Teora
- Axis A3) Avellino-Rocchetta Sant'Antonio
- Axis A4) Avellino-Venticano
- Axle A5) Avellino-Benevento

- Axle A6) Avellino-Nola

Each axis was symbolically represented with a line joining the starting point and the end point, as shown in Figure 1.

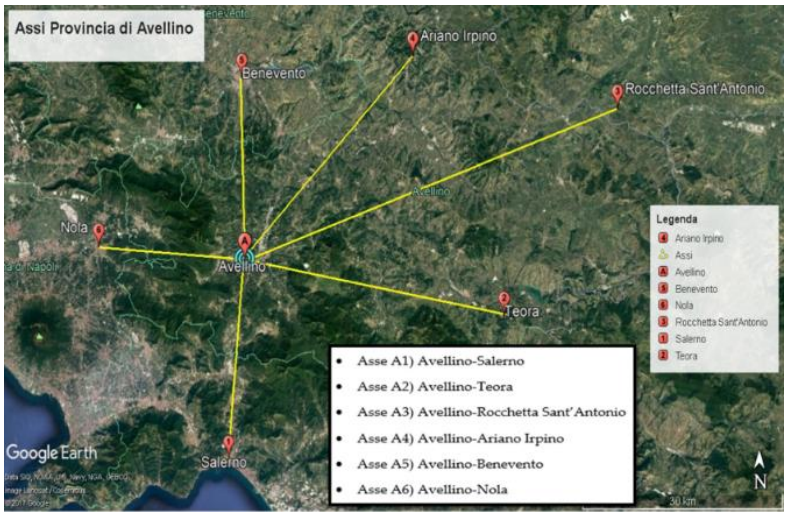

Fig. 1 - Selected travel axes in the analyzed area (Avellino province)

3.1 Description of the selected axes

Avellino - Salerno axis

By the Avellino-Salerno axis, we refer to the road that connected the Principato Citra, or Principato citeriore, (today's province of Salerno) and the Principato ultra or Principato ulteriore (today's province of Avellino), known as State Road 88 of the Two Principalities.

The SR 88 was established, on the route of the Via dei Due Principati, in 1928 with the following itinerary: Salerno - Mercato San Severino - Avellino - Benevento - junction with the No 87 at Ponte Landolfo with a length of 97.375 km.

The original route ran through the Irno river valley and the hills of Irpinia and Sannio, passing various localities including Baronissi, Mercato San Severino, Montoro Inferiore, Bellizzi Irpino, Avellino and finally Benevento and Morcone. Subsequently, the route was divided into several sections, each within the competence of its province:

- The section that crosses the Province of Salerno has been renamed Regional Road 88 and is divided into two sections: the first section, called SR 88/a, starts from the border with the Province of Avellino and ends at the junction with Provincial Road SP 222, i.e. in the hamlet of Monticelli of Mercato San Severino; the second section runs from the junction with Provincial Road SP 222 to the junction with Provincial Road SP 26, i.e. in the municipality of Pellezzano;
- The section in the Province of Avellino is called SP ex SR 88 and includes the municipalities of Atripalda, Cesinali, Aiello del Sabato, Bellizzi Irpino, Contrada, Forino and Montoro.

Avellino - Teora axis

By Axis Avellino-Potenza we refer to a section of the historic State Road 7 Via Appia, a highway that - following the route of the Roman consular road with the same name - connects Rome to Brindisi.

The section of interest for the research, chosen as the reference axis, originates from the Pianodardine junction passing through the municipal territories of Manocalzati, San Potito Ultra and Parolise. This section is very congested due to commuting from neighbouring municipalities to the provincial capital, in addition to regional and national traffic. At Parolise there is the junction between the old and the new route on a variant and with State Road 400 at Castelvetere.

The original section between Parolise and Lioni passed Salza Irpina, overcame the difference in altitude with the hairpin bends of the 'Malopasso' to reach Montemarano, crossed the Calore River at Ponteromito, and continued towards the suburbs of Sant'Angelo dei Lombardi and Lioni. The disused section from Castelfranci to Lioni was included in the itinerary of the State Route 400 of Castelvetere in 1990.

The variant built after the earthquake of 23 November 1980 (called Ofantina Bis) brushes farther south against the Montagnone of Nusco and the territories of Cassano Irpino, Montella and Nusco itself, with a less winding route and over viaducts and through tunnels.

The old route takes different local names for short sections (Via Nazionale, Via Appia, district names). The new route is entirely numbered as SS7, as can be seen from the kilometre progressions.

Once past the town of Lioni, the road separates from the motorway and returns to the old route towards Teora and Sant'Andrea di Conza. The state road enters

Basilicata in the municipality of Pescopagano, continuing with a winding route towards Castelgrande, Muro Lucano, Ruoti until the Appia reaches Potenza.

Avellino - Rocchetta Sant'Antonio axis

By Avellino-Rocchetta Sant'Antonio Axis we are referring to the historic railway line that connects the city of Avellino with most of the towns in the upper Irpinia region until reaching the province of Foggia, precisely Rocchetta Sant'Antonio. The first section of the line is mainly located in Lucania territory, with some encroachment into the province of Avellino as far as Conza. This section includes the stations of Pisciolo, Monteverde, Aquilonia, Monticchio, Rapone - Ruvo - San Fele and Calitri - Pescopagano.

All, unfortunately, distant from their respective towns. Passenger traffic is non-existent with the exception of Calitri. Near the Andretta - Conza station there is a beautiful, wide panorama of the artificial lake built at the end of the 1970s. Just beyond the lake and after passing through the Morra de Santis - Teora station, it is possible to reach Lioni, which is the major intermediate hub of the line and whose station is slightly different from the others, despite being the result of post-earthquake reconstruction.

The section from Lioni to Avellino is the most popular, also because the attraction of the Irpinian capital is felt more strongly. The population density of the crossed territory is certainly higher than that of the Rocchetta - Lioni section. Near Nusco, the Adriatic-Tyrrhenian watershed is crossed: in fact, the Ofanto valley is left behind before entering the Calore valley. The route of the line between Nusco and Avellino is 55 km compared to 24 km as the crow flies: in fact, the line makes a very wide loop to cross the Picentini mountains.

In this section there is the Bagnoli Irpino station, which is not far from the mountain resort of Laceno and the lake with the same name. It continues on, passing through the towns of Montella, Cassano Irpino, Montemarano, Castelfranci and Luogosano before arriving in the Irpinian capital, where the line enters next to the one coming from Salerno.

Avellino - Ariano Irpino axis

By Avellino-Ariano axis we refer to two fundamental connection roads in the Province of Avellino that see Venticano as their respective terminus of departure and arrival. The first is a section of the historic State Road 7 Via Appia that leads from Venticano to the gates of Avellino.

The first municipality reached on Irpinian land is Venticano, where the Appia is the main road in the hamlet of Castel del Lago.

This is also the location of the Benevento junction on the A16 motorway and the start of the Benevento motorway junction 9. Just after Castel del Lago, the road reaches the village of Calore di Venticano, where the State Road 90 of Puglia begins. From here the road changes direction and heads south-west, passing through the towns of Montemiletto and Pratola Serra. Near this last centre, the former State Road 371 of the Valle del Sabato branches off.

After crossing the industrial zone of Pratola Serra, the Appia enters the territory of the Manocalzati municipality. Here is the Avellino Est junction of the A16 motorway and the junction with State Road 7 bis of Terra di Lavoro (which in the Atripalda section is more commonly known as the 'eastern variant'), which leads to Naples and then Capua. The Appia does not enter the municipality of Avellino for a few hundred metres, although it is directly connected to the Pianodardine Industrial Area.

Continuing instead from Venticano, the second section of this axis begins, represented by the State Road 90 of Puglia. This passes through the municipalities of Mirabella Eclano and Grottaminarda before reaching Ariano Irpino. It then continues towards Foggia, passing through the municipalities of Savignano Irpino, Greci and Montaguto, the last municipality in Campania before entering Puglia in the municipality of Panni.

Avellino - Benevento axis

By Avellino-Benevento axis we again refer to the historic State Road 88 of the Two Principalities, this time considering the section from Avellino to Benevento.

To date, this has been subdivided into various sections of different jurisdiction. Starting from Avellino, it passes through the municipalities of Capriglia Irpina, Grottolella, Altavilla Irpina before arriving in the province of Benevento in the municipality of Ceppaloni.

Avellino - Nola axis

By the Avellino-Nola axis, we still refer to the historic State Road 7 Via Appia, and in particular to a part of the route that was abandoned in 1935 to become what was later called State Road 7 bis of Terra di Lavoro. In the post-earthquake years, much of the old route was revised, and a long, high-speed variant was built, divided into two sections, Villa Literno-Acerra and Acerra-Nola. The total rejoining

of the two sections gave rise to the Nola-Villa Literno Support Axis, a 45 km long, high-speed main road, which not only connects the municipalities but also makes the connection to the various industrial areas along the axis more usable.

The section of motorway ends shortly after the Nola Interporto, where the State Road SS 7 bis continues on the old route parallel to the A16 motorway, passing through many towns in the Nola area and then joining the lower Irpinia area. This part of the old route is the one we are interested in, which starts from Nola, the last municipality in the Province of Naples, and enters Irpinia in the municipality of Avella, continuing on to Sperone, Baiano, Quadrelle and Mugnano del Cardinale, from where, skirting the Partenio Regional Park, it reaches Monteforte Irpino.

ASSE A1	ASSE A2	ASSE A3	ASSE A4	ASSE A5	ASSE A6
Atripalda	Manocalzati	Salza Irpina	Atripalda	Capriglia Irpina	Mercogliano
Cesinali	San Potito Ultra	Chiusano	Manocalzati	Grottolella	Monteforte Irpino
Aiello del Sabato	Candida	Parolise	Pratola Serra	Altavilla Irpina	Mugnano del Cardinale
Bellizzi	Parolise	Montefalcione	Montemiletto	Cervinara	Sirignano
Contrada	Salza Irpina	Montemiletto	Venticano	S. Martino	Baiano
Serino	Montemarano	Lapio	Mirabella Eclano	Rotondi	Sperone
S. Michele di Serino	Torella dei Lombardi	Taurasi	Grottaminarda	Prata	Avella
S. Lucia di Serino	Villamaina	Luogosano	Frigento	Roccabascerana	Lauro
S. Stefano del sole	Gesualdo	San Mango sul Ca	Montecalvo Irp.	Ospedaletto	Quindici
Solofra	S. Angelo dei Lombardi	Paternopoli	Sturno	Summonte	Quadrelle
Forino	Guardia dei Lombardi	Fontanarosa	Santa paolina	Pietrastornina	Domicella
Montoro	Rocca San Felice	Castelvetere	Pietradefusi	Tufo	Pago del Vallo di Lauro
Mercato S.S.	Cassano Irpino	Castelfranci	Montefredane	S. Angelo all'Esca	Marzano di nola
Fisciano	Montella	Montemarano	Melito Irp.	Montefusco	Moschiano
Baronissi	Nusco	Cassano	Casalbore		Taurano
Pellezzano	Lioni	Montella	Torre le Nocelle		
	Volturara	Bagnoli Irpino	Flumeri		
	Calabritto	Nusco	S. sossio Baronia		
	Senerchia	S. Angelo dei Lon	S. Nicola Baronia		
	Caposele	Lioni	Castel Baronia		
	Sant'Andrea di Conza	Morra de Sanctis	Carife		
		Teora	Vallata		
		Conza	Trevico		
		Andretta	Bisaccia		
		Cairano	Bonito		
		Calitri	Vallesaccarda		
		Aquilonia	Scampitella		
		Monteverde	Villanova		
		Lacedonia	Zungoli		
			Ariano Irpino		
			Savignano Irp.		
			Greci		
			Montaguto		

Fig. 2 - Table-list of municipalities along the selected axes (in yellow the Salerno-Avellino reference axis)

3.2 Reference axis, pilot municipality and fractional focus

Once the analysis of the main axes was completed, we moved on to study the reference axis: the Avellino - Salerno axis.

The choice was made on the basis of the territorial location that sees this axis as the link between the inland areas and the sea (Salerno) and also for the greater availability of data and information. However, it must be said that the validity of the proposed method lies in its replicability and extension to any other area.

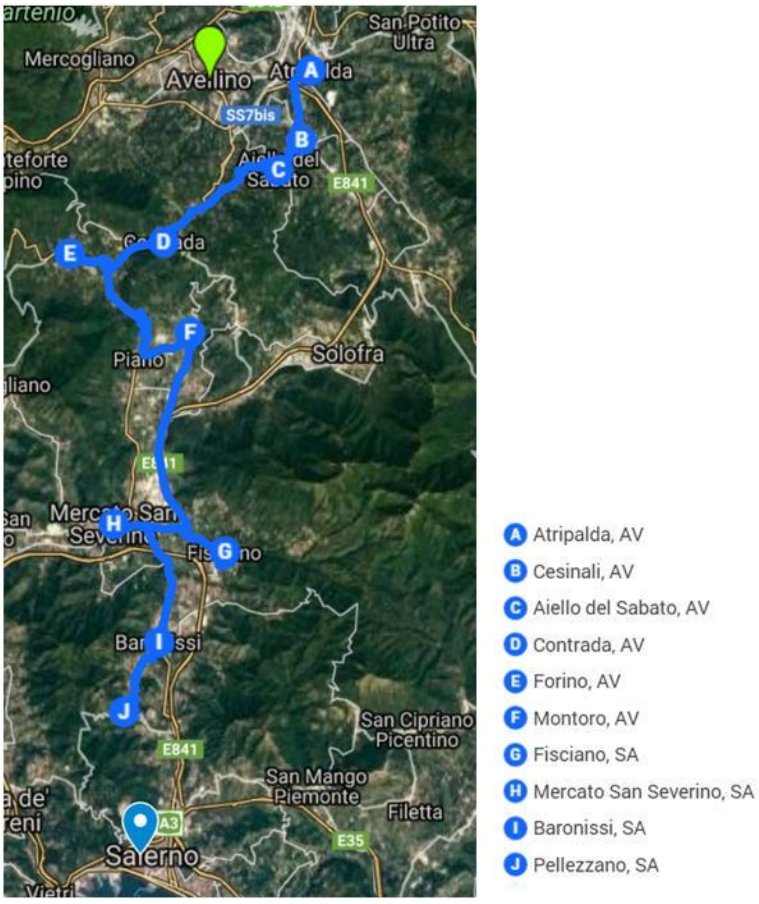

Fig. 3 - Identification of municipalities along the Avellino-Salerno axis

Once the first phase was over, we moved on to the census that involves the identification of all those assets of cultural interest and their subsequent inclusion in the DSS.

This phase, like the previous one, was carried out as an example for only one of the municipalities along the reference axis.

As enhancement in the broadest sense is the primary goal to be pursued, it is therefore first necessary to have a clear overview of the cultural assets available at the chosen site, distinguishing them into the following categories to be searched for in the area of interest, and then to include them in the spatial database:

- Castle, civil buildings of historical interest
- Villa or palace
- Church, abbey, sanctuary and places of worship
- Archaeological area
- Museum
- Rural building
- Historic garden
- Nature park

Various types of itineraries were then defined for up to four different topics, divided into the following routes:

- Historical-cultural route
- Environmental route
- Religious route
- Food and wine route

so as to rationally channel tourist interest towards the individual's subjective preferences.

In doing so, all areas of interest were involved, identifying and enhancing the attraction factors of each individual municipality. The term "attraction factor" is used to identify the reason for movement and thus an element of strategic importance in the analysis of the tourism phenomenon. This strategy must be based on the creation of specialised and distinctive tourism-territorial skills and on the ability to persuasively propose new, sustainable tourism ideas consistent with territorial identity, based on local interest elements.

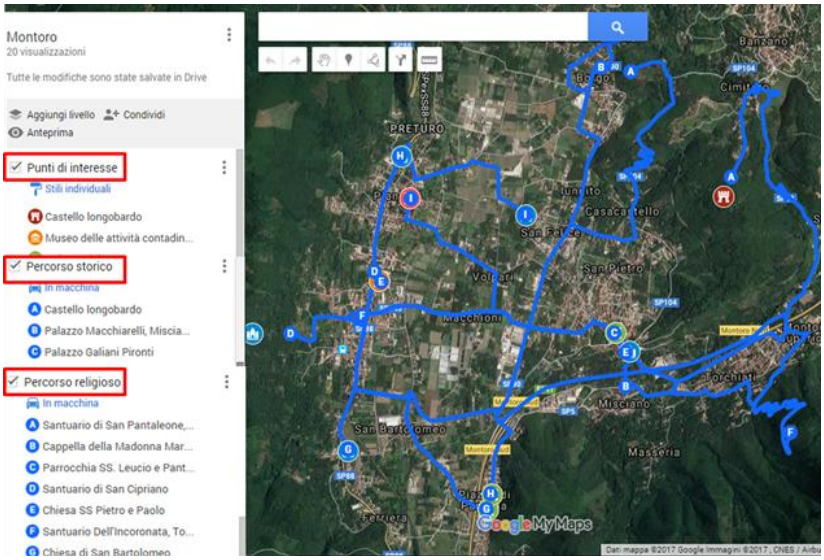

Fig. 4 - Municipality of Montoro. Punctual mapping of thematic routes

The integration of the surveyed information and routes within the tool defines a knowledge vector for those who want to know, communicate or intervene on the surveyed buildings, with the different promotional tools that will be available from time to time.

Lastly, the investigation of one of Montoro's villages, called Aterrana - whose typological and positional characteristics make it a real attraction for the entire municipality, as well as for the entire reference axis - was further deepened.

It is an old farming village, with simple architecture, crossed by alleys and narrow stone streets typical of the Middle Ages, ancient portals, courtyards with wells, a few churches such as the one devoted to San Martino with its beautiful baptistery and chapels, and the Angevin-style Montevergine church with a beautiful carved portal and an artistic pronaos.

The almost total immutability over time, made possible by the very few human interventions and the surprising resistance shown during the different telluric phenomena, makes the village of Aterrana a more than significant prototype of a small historic centre to be preserved and enhanced. The first step to proceed in this direction is the territorial framing of the area to be analysed.

The urban conformation of the Aterrana village is defined by the layout of Via Madonna delle Grazie and Via Fontana; in fact, starting from the Chapel of the Madonna delle Grazie, and continuing along the street of the same name, it is

possible to reach the centre of the village. The second, Via Fontana, makes it possible to arrive at the greenest and most wooded part of Aterrana, which leads, via the Candelito path, to the Sanctuary of San Michele on the peak of the mountain with the same name, at 1567 metres above sea level.

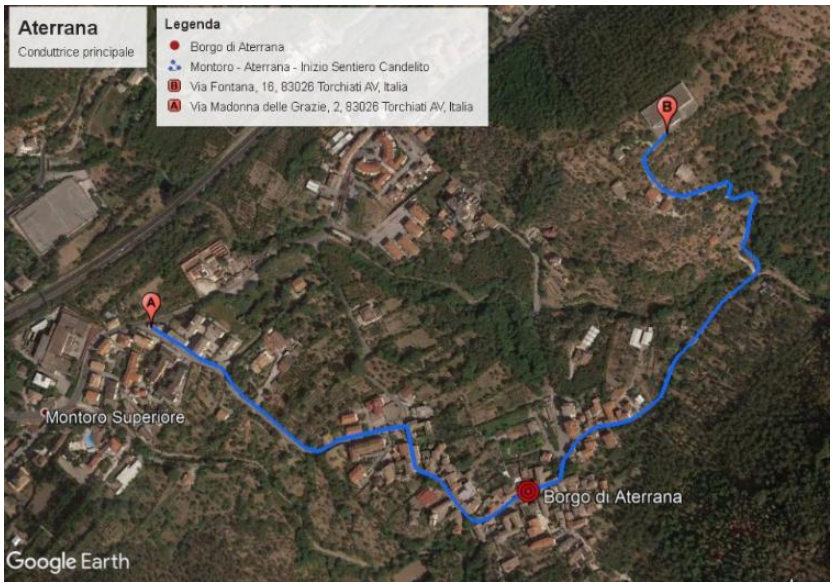

Fig. 5 - The Aterrana village

A careful bibliographical research at the University of Salerno Libraries, the Provincial Library of Avellino and the State Archives of Avellino, supplemented and expanded by as many web searches, made it possible to acquire a good information repertory to use as a starting point.

We then proceeded with the identification of the village's boundaries and its positional analysis in relation to the geographical area to which it belongs, in order to contextualise the intervention according to the potential of the village site.

We then moved on to the precise identification of all the assets of historical-cultural, religious and environmental interest, in line with the pre-established thematic routes.

Once the research phase was completed, we proceeded with the implementation of the database relating to the assets in all identified categories, in order to create a 'geo-referenced cultural map' of Aterrana.

The structure of the georeferenced system required the database to be organised in different topological tables, whereby each table contains only those assets that will then be identified on the map with the same topological element (point, areal or linear element).

In the case study, point and linear elements were used. The first were used to identify all the buildings and general points of interest; the linear elements, on the other hand, were used to identify the route that includes the aforementioned elements, and the nature trails.

The following tables were thus achieved:

Tab. 1 - Table of historical-architectural assets in the Aterrana hamlet

MUNICIPALITY	HAMLET	ID	Use destination/Name	Year or Period
MONTORO	Aterrana	1	St. Martin's Complex	1300
MONTORO	Aterrana	2	Church of Montevergine	1534
MONTORO	Aterrana	3	De Leo Palace	XVIII sec.
MONTORO	Aterrana	4	Masucci - De Giovanni Palace	XVII sec.
MONTORO	Aterrana	5	Rocco Family Palace	XVI-XVII sec.
MONTORO	Aterrana	6	Curcio Palace	XVI-XVII sec.
MONTORO	Aterrana	7	Abignano Saracino Palace	XVI-XVII sec.
MONTORO	Aterrana	8	Vietri - Giaquinto Palace	XVI-XVII sec.
MONTORO	Aterrana	9	De Leo Garden	XVIII sec.
MONTORO	Aterrana	10	Masucci - De Giovanni Garden	XVII sec.
MONTORO	Aterrana	11	Rocco Family Garden	XVI-XVII sec.
MONTORO	Aterrana	12	Curcio Garden	XVI-XVII sec.
MONTORO	Aterrana	13	Abignano Saracino Garden	XVI-XVII sec.
MONTORO	Aterrana	14	Terlizzi Courtyard	XVI-XVII sec.
MONTORO	Aterrana	15	Ferrazzano Courtyard	XVI-XVII sec.
MONTORO	Aterrana	16	Vietri-Giaquinto Courtyard	XVI-XVII sec.
MONTORO	Aterrana	17	Ventara Cave	Mesolithic
MONTORO	Aterrana	18	Balzi del Guacci Cave	Mesolithic

Comparing this last table with the one drawn up for the entire Municipality of Montoro, it is evident that in this case no reference routes have been defined for each identified asset. This choice is essentially motivated by the modest extension of the hamlet and the homogeneity of the characteristics of the assets located in it. In support of this choice there is also a key consideration, namely that most of the existing assets are encountered by travelling along the main road (via Madonna delle Grazie).

The many nature trails that branch off from the village through the surrounding mountains deserve a separate remark. The 'Wikiloc' portal itself, the largest online database of nature trails in the world, promotes no less than five of them starting right from Aterrana. A second table has therefore been drawn up for their identification, since a different topological sign (linear) is required for their representation in QGIS.

Tab. 2 - Trails identified and included in the Georeferenced Information System

MUNICIPALITY	HAMLET	ID	PATHS AND TRAILS	LENGTH
MONTORO	Aterrana	1	Candelito Path	6 km
MONTORO	Aterrana	2	Madonna dell'Incoronata Trail	2 km
MONTORO	Aterrana	3	Picentini Mountains Trail	16 km

Once this further phase was completed, we proceeded to the punctual identification on a satellite map of each element described in the table, using the programme Google Earth Pro. A different symbology was used depending on the use destination of the identified asset to simplify the reading of the data, and a legend was then prepared.

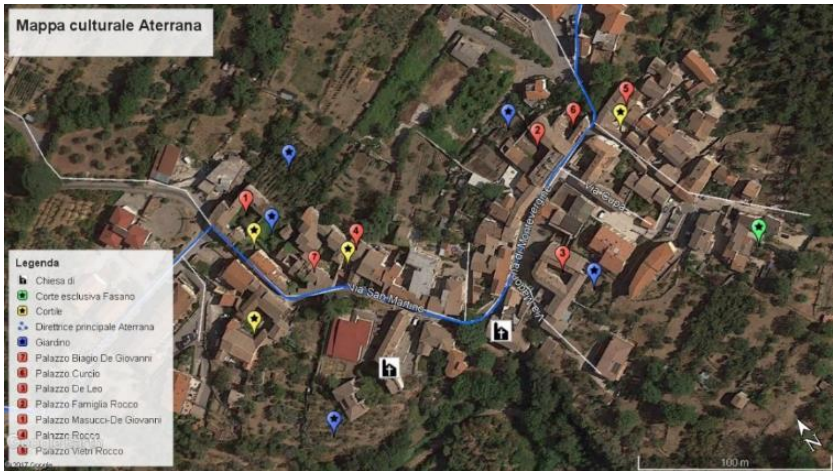

Fig. 6 - Map of cultural attractions identified in the Aterrana village

The file thus created was exported in .kml format and subsequently uploaded to the QGIS platform, which, using the same reference system as Google Earth Pro, allowed immediate re-localisation of all the identified elements.

This led to the last phase where the geographical information of each asset (georeferencing) was associated with the alphanumeric information previously processed through tables. An instantaneous interrelation between the processed data was thus obtained, thus achieving what was the initially set goal.

4 Discussion and Conclusions

This paper summarises the outcomes of a research project that addresses, from a theoretical point of view, the problem of designing a decision support system with explicit consideration of the geo-spatial dimension (Spatial Decision Support System - SDSS) in order to support the knowledge and valorisation of cultural heritage in small towns.

The proposed conceptual framework has been applied to a case study, but it should be emphasised that the validity of the method lies in the possibility of applying it to any other context, gradually integrating the amount of data. This integration is guaranteed by the proposed Planning Framework, which represents the conceptual and operational basis for the SDSS.

Future developments lie in the identification of the components of the SDSS in terms of basic data, indicators and models and the extension of the webgis component.

This component makes it possible to visualise and query georeferenced information and their associated maps, proving to be a valuable tool for the knowledge and dissemination of cultural heritage.

It also allows the establishment of 'collective identity' places, and can become a starting point for the development of cultural routes in the sustainable tourism field.

This is because supporting the knowledge of cultural heritage can be the trigger of a virtuous mechanism and an economic, tourist and social driver as a prerequisite for a desirable reversal of the phenomenon of depopulation, abandonment and degradation, especially in inland areas.

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The Hidden Knowledge: A Hermeneutic Approach to Sustainable Development of Rock Hewn Settlements. The Case of "Tigray Region, Ethiopia" and "Sassi Matera, Italy"

Betel Workeye Wondimu*

Faculty of Architecture and Urban Planning
Arbaminch University, Ethiopia

Beimnet Kassaye Beyene

Faculty of Architecture and Urban Planning
Arbaminch University, Ethiopia

* *Corresponding author*

Abstract

The Ethiopian, especially the Tigrian Region, society had been using earth as a construction material since days which cannot be traced back. They chiselled and curved their important shelters out of Mountains. These spaces proved themselves to be of outstanding construction wisdom that they are habitable and sustainable today as they were years ago. Besides the context, Mother Nature had always been the perfect building construction material for ages in different parts of the world where our instinct human nature led us to. The basic comparison to be discussed in this paper will be the case of Sassi Matera, Italy and Tigray, Ethiopia. These locations are known to be one of the first human settlements in the world with same type of structures.

This research will find similarities of sustainability among the two regions in their settlements, culture, Religion and 'Being'. Study 1 focused on grouping these construction techniques of both locations into different groups based on their typologies. After exploring some of the typologies from each regions, similar typologies from each were filtered out and further studied. Study 2 Focused on Literary sources of studies and Found that 'Being' to be the basic source of knowledge in Ancient construction techniques. Study 3 Examined the role of Religion and Culture in the regions for the development of 'Being' and its impacts on knowledge development as 'Being in the World'. Study 4 Emphasizes on the importance of Hermeneutic Phenomenology as a knowledge management strategy for sustainable development in the built environment in a globalised setting.

The Research findings will be useful in understanding knowledge as 'Being' and 'Being in the World' for sustainable developments. It also brings us back to translating existing

knowledge of a new/modern yet sustainable, an old/ancient yet long-lasting approach to creating the new sustainable development intended in the country or even worldwide.

Keywords – Hermeneutics, Ancient Technologies, Sustainable Development, Knowledge Translation, Being-in-the-World

Paper type – Academic Research Paper

1 Introduction

'There is no world without man … There is no Architecture or World without man. The relationship between man and the world is not that of a coinherence of subjects or objects but rather existential involvement and participation.' (Sumner, 1974)

If we need to go through a healthy thinking process in Architecture, then let us evolve from the beginning – Man, the Ancient Man. To look into it better, two of the ancient civilizations with world's epic heritage sites are selected for this research.

Tigrai region, at the Northern part of Ethiopia, pervades an area of 53,638 sq km, with population number about 4.3 million from the 2007 census, with an estimation of it becoming 7.1 million by 2020 and an altitude from 600-3900 above sea level. Tigrai above all known for being the base to the Axumite civilization that shaped the hardwired Christian tradition of Ethiopia; is home to various Christian churches featured with their rock-hewn, freely standing rock structures and rock-built architecture. The Tigrai region is thought to have around 200 churches of this kind with in its territory even though only few of them are frequently visited. Thus churches are estimated to have been built from the 6th and 7th centuries B.C (which is during the pre-Christian Ethiopia) up to 200 years aback. In addition to the rock paintings that reveal the pre-Axumite cultural life, cultivation scenes, domestic and wild animals and other artful scratches mostly located nearby the towns of Abyi-adi, Adigrat, Edaga-hamus, Axsum and Shire; there on the inside faces of the churchs` walls are drawn, vibrant paintings that narrate the cultural and religious narratives.

On the other Side; cave houses of Matera, Sassi, are believed to be one of the first human settlements in Italy, 9,000 years ago. After a war the city was empty for decades, the people which used to live there relocated. People started moving back to Matera from the 1980s. Once which was the shame of Italy is now with all the renewals gained UNESCO world heritage listing in 1993 and is now more prosperous, but there has been no jarring change in appearance or atmosphere.

Because Matera is a mix of various landscapes, structures, civilizations, and cultures, its history is intricate and intriguing. The systematic attempt to reduce the rock city to the norms of the culture of the European city began with the Byzantine and Eastern civilizations and continued through the arrival of the Normans. The city has been built and finished over the course of the last eight centuries, and throughout that time, architects from the Romanesque to the Renaissance to the Baroque have attempted to create the city while also overcoming the pre-existing rock habitat's natural resistance. Matera is currently facing the challenges of renovation, sustainable recovery, and reclaiming lost identity. It does so once more under the flag of European urban culture.

The thematic scope of this study is to find meaning and similarity in Ancient construction techniques, Rock hewn churches to be specific, and Architectural space expressions of human beings which lived in the same era in different parts of the world, Tigray region and Sassi Matera, Italy.

From Matera, Italy - Crypts of the Murgia, Rock-Hewn Churches, Destroyed Churches and From Tigray Ethiopia - Endarta Awraga Churches, Adowa Awraga Churches, Hulet Awlailo Awraga Churches, Tembien Awraga Churches and Agame Awraga

2 Data

Sant'Eustachio de Posterga*;** a regularly, fully excavated rock hewn church has many of the space features most large, regular, and fully excavated Rock hewn Churches in Tigray have. ***MARIYAM WKRO NEBOLET, GABRIAL TSILALMA'O, MEDHANEALEM ADI KASHO, MARYAM HITSEWTO, GABRIEL WUKIEN are the churches from Tigray which has Major similarity with Sant'Eustachio de Posterga..

2.1 Sant'eustachio De Posterga

The Benedictine crypt of S. Eustachio is near the Cathedral and precisely in the garden of the Conservatory of S. Giuseppe in via Riscatto. It remained the place of worship of the ancient monastery until the large three-aisled temple consecrated on 6 May 1082 by Archbishop Arnaldo in the presence of Bishop Benedict and Abbot Stefano was built on the same crypt. The monastery, which in 1093 hosted Pope Urban II with its numerous courtyard ', for some events it lost its prestige and was closed around 1250. Part of the monastery was destroyed; part was destined for the construction of the archiepiscopal palace and the residual part in

1594 housed the Conservatory of S. Maria della Pietà. Even the subdivided church, reduced to a Cappellone, was definitively demolished on the construction of the new seminary.

Of all the monastic complex remains the crypt, which from a document found in the archives of the Ridoola museum, resulted in a square plan divided by nine pillars. This hypogeum was not practicable because it was clogged with rubble resulting from the construction of the Seminary (1904-1906) and from the demolitions of the Vico Campile. With the clearing of the rubble carried out in 1992, it was possible to bring the ancient structure of the crypt back into full light, confirming the summary news that was available. And with three naves of which the lateral ones are wider than the central one; the square pillars leave space for nine well-made domes. We can see remains of frescoes and there are some graffiti with the inscriptions: S. Leo, S. Benedictus, S. Maurus, S. Scolastica. And a small monument, partly excavated and partly built that deserved to be recovered, and this crypt, at the time of the Protospata (1093), was held in such consideration that it was chosen to house the remains of Abbess Eugenia of the monastery of holy ucia and Agata, who died in the smell of holiness.

2.2 Mariyam Wkro Nebolet

From the main road *Adowa-Adigrat*, just before reaching *Enticcio*, branch off to take the first road that crosses the well-watered agricultural area of Hahaille to the darker area of *Ambaseneiti*. 56 miles about driving very rough and wading through many streams, along the main road, in an austere setting, is the town of *Nebolet*; Another 15/20 minutes by car is the church.

In a churchyard with vegetation and tall bamboos, the natural stone facade with two doors and two raw windows does not evoke the intricately carved interior. This church and its pronaos are beautifully sculpted, much finer detail than most examples, possibly due to the quality of the sandstone but also due to the craftsmanship.

The church has three compartments, three compartments deep, with the central nave significantly higher than the stone ceiling of the side compartments. The ends of the brackets are bounded by smooth flat projections; Axumite details are quite subtle. The door to the left leads to a carved domed pronaos - a strange double dome with no central support on the main shaft, a carved throne on the far-left wall. Some paintings are late, but the carvings in the center of the dome

are more interesting. The side aisles have longitudinal flat beams and through the domes have flat roofs significantly lower than the center. There is also access from the pronaos via a partial ambulatory. Above the arch of the sanctuary is a rope-like sculpture found in *Ghioghios, Maikado* and elsewhere in *Tigray*.

There is another church, *Ghiorghios*, which is essentially an extension of *Mariyam Wkro*, accessed by a crude wooden ladder to the left of the lower church door. It was carved into the rock at a height high enough that the openings in the ground of *Ghiorghios* overlooked the left roof of the aisle or the center of the main nave. It is a simple rectangular space divided into two unequal parts by a double dome and a flat, low ceiling. Concerning Mariyam, *Wkro*, it shows an advanced understanding of levels. The two churches together are interesting because of the beautiful details of Mariyam; unusual carved protrusions are left between the domes – a real attempt at creating a plastic form; the use of different levels and the complete absence of most facades.

2.3 Gabrial Tsilalma'o

One mile east of the *Adigrat-Senkate* main road, in a vast green valley where baboons play among trees and water meadows. A car can get to the church within a quarter of a mile, about 30m south of the mountain.

With only one more porch the church is completely carved behind the rock face. An unusual feature is an entrance through an opening with a single column supporting the stone roof and two hermit cells or mass graves in the rear wall. The carved church has huge cross-shaped columns with double-framed capitals. The weird thing is that each column has a curved part below and a square part above, as if they were trying to copy the Greek Doric order, where the square abacus is above the curved echinus. The domes are cut out and all the gaps in the roof are carefully carved. Two unusual windows are carved in the rock face, with rectangular indentations presumably attempting to mimic an Axumite detail.

2.4 Medhanealem Adi Kasho (Selected)

In the mountains east of the main road *Adigrat* to *Wkro*, north of the last town. The church can be accessed by walking distance to Petros and Pawlos, *Mikael Melehazenghi* and *Biet Mekai*. 30/40 minutes pleasant walk through a rock face, to a beautiful setting among olive trees, surrounded by a church wall, with a gate.

The façade was originally carved into the rock, showing four independent standing columns with square ends, supporting the roof or the rock above, now built between the two. The original exterior wall of the church is behind the open colonnade, with a thin wooden ceiling. The church entered through two magnificent wooden doors and carved into the sandstone, the central bay wider than the two naves and jutting out over massive columns, unusually carved headstones; Axumite detail runs the length of the nave on both sides and the end wall. There is a single dome at the end wall of the sanctuary. There is a single dome at the end walls of the sanctuary. The whole roof is sculpted in a series of different patterns, showing great imagination, and drawing according to the plan. Pronaos features circular areas at each end and Aksumite detailing on the church's façade. The churchyard has rudimentary stone tombs. There are several crosses and paintings carried in the procession.

2.5 Gabriel Wukien (Selected)

After a 20-minute drive North from *Abi Addi* to where the road splits into *Adowa* or *Mekelle*. From there is difficult and rocky 2hr walk through the sprawling countryside. The church complex is below the cliff and offers stunning views, as far east as Guh and as far southwest as *Abi Addi*. The last 30m are in the monastery complex, a steep walk through the rocks, to the church itself, surrounded by the usual walled enclosure.

This church is significantly comparable to *Mariyam*, *Wkro* and *Medhane Alem*, *Adi Kasho* in that it is a carefully carved, detailed rectangular church. In addition, it has an ambulatory completely hewn on three sides, now covered by flat stone slabs. The walkway continues in the open air and is flanked by three self-supporting arches, carved into a monolith. Inside the stone pronaos and above the doorway leading from it to the church are a series of rather small-scale blind domes, used more often in Tembian than in Axumite details. The church is not only finely carved, but the use of floors is also understood and used, such as at the entrance where one passes through the tunnel. It is so completely hidden that as soon as you get close, you have no sense of scale.

Inside the church there are three compartments and four deep compartments, with a dome dividing the third and fourth space, otherwise the roof is completely flat beams. The ceiling has some pattern but is largely unadorned or has only a shallow dome. The capitals are almost all double in shape, and because of the flat

roof the four beams meet at the same height. It can be said that, to maintain the beam of the flat roof, in the third span, the column starts from a supporting pillar going up to the column face, not from the ground; Of course, this isn't strictly necessary, but it does show a lot of imagination and appreciation for the material. A row of small domes runs across the church at ceiling height, in front of these domes, and below is a double circular ledge, even carved on the long pillars above. These domes do not have pointed ends but continue in a straight line from the ground. Some columns have a cross shape, while others have a square plan.

2.6 Maryam Hitsewto (Selected)

Drive 20 minutes north of *Abi Addi* a route to *Adowa* and *Mekelle*; then walk 15-20 minutes in the foothills south to the mountain range, where *Debra Amba Dellase* sits at the top. Completely carved into the rock, the small chapel has an unusually continuous hipped roof that extends to the nave with carved crosses all the way to the very end and a carved cross above the arch in the palace. St. The roof is flat with walkways with a vertical plane extending into the church, protruding, and forming a continuous pediment, very similar to the traditional Tigrayan practice.

3 Data Analysis

3.1 Functionality

For *Sant'Eustachio de Posterga* – 'a **square plan** divided by **nine pillars**'... 'And with **three naves** of which the lateral ones are wider than the central one; the square pillars leave space for nine well-made domes.'

'The church is covered with **planks**, **beams,** and **tiles**. In truth, the whole **roof** lets water pass into the church, the **floor** is made of stone boards, the **altar** was built from scratch, therefore it does not have its own vestments, for example the red silk pallium and the chasuble, also made of silk red they are not of the church instead the tablecloths belong to the canons don Luca, don Antonio, don Caione who serve mass there. Above the **altar** there are **figures** on the wall [we don't know if they could be statues positioned in niches but most likely they were **frescoes**] worn due to age. In the center, still above the **altar**, is a small **window**.

Inside this church there are three other ancient wooden portable **altars** with a small stone table in the center. All around the church are **figures** of Mary in need of repair especially those found on the left-hand side of the church **entrance**. The doors are closed with locks and keys. Above the door is a **bell tower** with a small bell. On the left side there is a small **door** through which one descends to **another room below the church** which is dark and therefore is of no use. The bishop gives orders to repair the roof with Planks and beams, with tiles so that the water no longer flows inside the church. Then he orders that a canvas icon with the figure of St. Eustace be made on the main altar, to provide for the pallium, some tablecloths, a portable modern wooden altar with candlesticks and a wooden cross and to wall up the door located on the left side of the church and to do everything within three months.

For *Mariyam Wkro Nebolet* - 'The church has **three aisles**, **three bays** in depth, with the **central bay significantly higher than the stone ceiling** of the **side aisles**. The ends of the brackets are bounded by smooth flat projections; Axumite details are quite subtle. The **door** to the left leads to a carved **domed pronaos** - a strange double **dome** with **no central support** on the main shaft, a **carved throne** on the far-left wall.' ... 'The **side aisles** have longitudinal **flat beams** and through the domes have **flat roofs** significantly **lower than the center**.'

For *Gabrial Tsilalma'o* – 'With only one more **porch** the church is completely carved behind the rock face. An unusual feature is an **entrance** through an opening with **a single column supporting the stone roof** and two **hermit cells** or mass graves in the rear wall. The carved church has huge **cross-shaped columns** with **double-framed capitals**. The weird thing is that each **column** has a curved part below and a square part above, as if they were trying to copy the Greek Doric order, where the square abacus is above the curved echinus. The **domes** are cut out and all the gaps in the **roof** are carefully carved. Two unusual **windows** are carved in the rock face, with rectangular indentations presumably attempting to mimic an Axumite detail.'

For Medhanealem Adi Kasho – 'The **façade** was originally carved into the rock, showing **four independent standing columns** with square ends, supporting the **roof** or the rock above, now built between the two. The original exterior wall of the church is behind the open colonnade, with a **thin wooden ceiling**. The church entered through two magnificent wooden **doors** and carved into the sandstone, the **central bay wider than the two naves** and jutting out

over **massive columns**, unusually carved headstones; Axumite detail runs the length of the **nave** on both sides and the end wall. There is a single **dome** at the end wall of the **sanctuary**. There is a single dome at the end walls of the sanctuary. …The churchyard has rudimentary **stone tombs**.'

For Gabriel Wukien – 'It has an ambulatory completely hewn on three sides, now covered by **flat stone slabs**. The walkway continues in the open air and is flanked by **three self-supporting arches**, carved into a monolith. Inside the **stone pronaos** and above the doorway leading from it to the church are a series of rather **small-scale blind domes**, used more often in Tembian than in Axumite details. The church is not only finely carved, but the use of **floors** is also understood and used, such as at the **entrance** where one passes through the **tunnel**. It is so completely hidden that as soon as you get close, you have no sense of scale. Inside the church there are **three aisles** and **four bays in depth**, with a **dome dividing the third and fourth space**, otherwise the **roof** is completely **flat beams**.'

For *Maryam Hitsewto* – 'Completely carved into the rock, the small chapel has an unusually **continuous hipped roof** that extends to the **nave** with carved crosses all the way to the very end and a **carved cross above the arch in the palace**. The **roof is flat** with walkways with a **vertical plane extending into the church**, protruding, and forming a **continuous pediment**, very similar to the traditional Tigrayan practice.'

3.2 Ornament (Artistry)

For *Sant'Eustachio de Posterga* – 'The crypt, with its distinct architectural features such as niches and altars, is decorated with a collection of pictures from the 17th century. A narrow passage leads to the center of the catacombs: a side chapel is well preserved and on the left wall is decorated with a large fresco depicting Saints Peter and Paul. Opposite, another picture represents St. Mary standing with the Child. Also stunning is the fresco inside the cathedral, around the altar, depicting the Feast of the Demolition of the Cross and Our Lady kneeling to embrace Jesus. The central nave is left with only the left wall, interspersed with three niches and many altars created inside the wall.'

For *Mariyam Wkro Nebolet* – 'In a churchyard with vegetation and tall bamboos, the natural stone facade with two doors and two raw windows does not evoke the intricately carved interior. This church and its pronaos are

beautifully sculpted; much finer detail than most examples, possibly due to the quality of the sandstone but also due to the craftsmanship.'

For *Gabrial Tsilalma'o* – 'The carved church has huge cross-shaped columns with double-framed capitals. The weird thing is that each column has a curved part below and a square part above, as if they were trying to copy the Greek Doric order, where the square abacus is above the curved echinus.'

For *Medhanealem Adi Kasho* – 'The whole roof is sculpted in a series of different patterns, showing great imagination, and drawing according to the plan. Pronaos features circular areas at each end and Aksumite detailing on the church's façade. ...There are several crosses and paintings carried in the procession.'

For *Gabriel Wukien* – 'The ceiling has some pattern but is largely unadorned or has only a shallow dome. The capitals are almost all double in shape, and because of the flat roof the four beams meet at the same height.

It can be said that, to maintain the beam of the flat roof, in the third span, the column starts from a supporting pillar going up to the column face, not from the ground; Of course, this isn't strictly necessary, but it does show a lot of imagination and appreciation for the material. A row of small domes runs across the church at ceiling height, in front of these domes, and below is a double circular ledge, even carved on the long pillars above. These domes do not have pointed ends but continue in a straight line from the ground. Some columns have a cross shape, while others have a square plan.'

3.3 Symbolic Function

For *Sant'Eustachio de Posterga* - Probably the church of S. Eustachio de Posterga fell into disuse in the second half of the 17th century, as happened for many rock churches of the Sassi of Matera. The absence of mention in the Pastoral Visit of 1667 by Msgr. Lanfranchi proves this hypothesis. Many rupestrian churches present in the Sassi instead *'were stripped of the dignity of a sacred place'* between 1678 and 1702 by Archbishop Antonio Del Ryos.

The benefit of *S. Eustachio de Posterga* continued however to exist; we learn this from the 1732 declaration made by the «*Master Rev. Lionardo La Greca archpriest of this lonely 80's metropolis. He owns the patrimonial goods: a benefice under the title of S. Eustachio la Postergola which yields him 16 ducats per year with the weight of celebrating a mass a week which benefice is assigned to you for*

him, his patrimony ». In a document dated 1740 the benefice was still in his possession and among the other assets he enjoys, he also includes *«two houses in the district of S. Pietro de Morronibus, just below the houses of D. Giambattista Gambaro, where the monizaro was; they are waterfalls and there is an empty place*".

4 Summary of Findings

The Data Analysis has found that majority of the features in the spaces of the five rock hewn churches in Tigray Region proved to be of high similarity with the selected church in Matera, Italy. But as much as the similarities between them, it's also important to underline the differences at hand.

One of the major differences the selected church in Tigray has with *Sant'Eustachio de Posterga* was their access point. The Tigrian churches has their doors (entrance points) at the side while the access point for *Sant'Eustachio de Posterga* was from above which makes the Church one of the rock hewn typologies of 'Underground' while the Tigrian churches are of the types of 'Into the Ground or into the Rock'. (These names have been used interchangeably in some documents.) The other major difference is – The Tigrian rock hewn churches are still places of worship and are being actively used by the priests living there if not by the congregation as frequent as possible while *Sant'Eustachio de Posterga* was inactive for years now and part of it being destroyed. Since its discovery the church has been open to visitors, researchers, and nothing more.

Another one will be – even if the Tigrian churches have more activity and History than *Sant'Eustachio de Posterga*, there are detailed studies out there and plans to do more research. The Tigrian churches even with a lot of features to be studied are not well documented yet. The other barrier for interpretation will be the fact that almost all research is made by foreigners than local researchers. The challenge is clear in the documents that the foreign researchers find it difficult to record the data they collected with its originality. An obvious example for this is that names of the churches have different spellings in each document which makes it difficult to cross check for hermeneutic research such as this.

The general outline of all the selected plans is a square plan. Not just that all the churches have 6 to 9 pillars. These plans are clearly cross-like curved in the Tigrian churches but in *Sant'Eustachio de Posterga* are slightly cross shaped (not as clear as the previous). The other similar element is the Domes. Even if they

differ in number and location almost all, except *Maryam Hitsewto*, have domes. In *Sant'Eustachio de Posterga* there are 9 domes, In *Mariyam Wkro Nebolet* – 2 Domes, 6 in *Gabrial Tsilalma'o*, one Dome in *Gabriel Wukien* and *Medhanealem Adi Kasho* which is located at the end wall of the Sanctuary unlike the others' domes being located on the roof/ceiling. Besides earth, which is obvious for rock Hewn Churches, all the churches have their roofs and floors constructed out of local Wood and Stone. Wherever there are no domes all the roofs are flat roofs. Another similar design consideration is the scale play. In *Sant'Eustachio de Posterga*'s three naves – The lateral ones are wider than the central one while in *Mariyam Wkro Nebolet* – the central bay higher than the stone ceiling of the two side aisles. In *Medhanealem Adi Kasho* the vertical bay wider than the two side naves. This scale play exists in *Gabriel Wukien* as well, where this time the design dynamic happens around the entrance where one loses sense of scale as one gets closer.

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